# REGIONAL INFORMATION & ASSESSMENT CRITERIA



**SAN FRANCISCO**
**Bay Region**

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**Wastewater**
**Solids Study**

no slip

# SAN FRANCISCO BAY REGION
# WASTEWATER SOLIDS STUDY

## TASK REPORT 3-7.1
## REGIONAL INFORMATION AND ASSESSMENT CRITERIA

AUGUST 19, 1977



Sewage sludge -- CA -- SF
metro area

BY: ENVIRONMENTAL IMPACT
PLANNING CORPORATION

RUSSELL FAURE-BRAC
PROJECT MANAGER

SAN FRANCISCO BAY REGION WASTEWATER SOLIDS STUDY
3505 BROADWAY, SUITE 815, OAKLAND, CALIFORNIA 94611
TELEPHONE: (415) 547-6550

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# SECTION I
# INTRODUCTION

## A. OBJECTIVE

The twofold objective of Task 3-7.1 is to develop assessment criteria for evaluating environmental and social impacts and to establish a regional data base to be used in the development of the Wastewater Solids Study.

## B. ORGANIZATION OF REPORT

This Task Report is organized into three major parts in addition to this Introduction. The Summary (Section II) is a condensed version of Bay Region Characteristics (Section IV). This summary has been prepared so that it may be inserted into Chapter 2 of the Project Report/EIR/EIS. The Impact Assessment Criteria (Section III) have been developed to evaluate environmental and socioeconomic impacts of wastewater solids management.

## C. STUDY METHODOLOGY

### 1. Impact Assessment Criteria

The development of the impact assessment criteria was coordinated closely with ABAG's "208" Environmental Management Plan to insure compatibility with their Assessment/Evaluation Program. An impact assessment criterion matrix was used to reduce ABAG's assessment checklist to a realistic number of criteria and to tailor the criterion list to the Wastewater Solids Study.

The purpose of the matrix is to provide a screening mechanism. The matrix indicates where there is no identifiable link between an option for processing, transportation, or disposal and an assessment factor. It also indicates the nature or level of impact, which focuses impact prediction on appropriate assessment factors. The rankings shown in the matrix denote the degree of effort or depth of analysis required to predict the impacts of an option. Assessment factors that were determined to have no significant relationship to a particular wastewater solids option were identified and explained in the following text.

Once the impact assessment criterion matrix was completed, a checklist based on ABAG's assessment criterion checklist was developed. It is organized into four broad categories--environmental, institutional and financial, economic, and social--and shows special types of impacts that might be associated with the various options. Not every factor that appears on the checklist will be used to assess every option. The process is designed to insure the identification of the most relevant and meaningful impact information.

## 2. Background Environmental Conditions

Once the impact assessment criterion checklist and matrix had been developed, an analysis of the San Francisco Bay Region was conducted using the checklist as a guide to indicate background environmental conditions that appear to be pertinent to the Wastewater Solids Study.

## 3. Graphic Analysis

The procedure of selecting and evaluating land areas suitable to locating wastewater disposal sites is focused on graphic analysis. The purpose is to (1) provide a mapped inventory of environmental features directly applicable to the needs of locating disposal sites and related facilities, and (2) to establish the relative environmental suitabilities of the regional landscape for locating disposal sites based on constraining factors derived from quantitative and qualitative standpoints. Table 1 lists the maps used to display all environmental information in Task 3-7.1.

With the exception of Figures 1 and 2, all maps identify land areas that are either exclusionary or constraining to locating disposal sites. Exclusion areas will not be considered for site selection and constraint areas will require detailed evaluation to assess all potential environmental impacts and required mitigating measures.

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| Water Resources | 4 |
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# SECTION II
## SUMMARY
## BAY REGION CHARACTERISTICS

This summary is a condensed version of the more detailed description of Bay Region characteristics found in Section IV. The summary has been prepared so that it may be inserted into Chapter 2 of the Project Report/EIR/EIS.

For the purpose of this Task Report, appropriate tables have been included in the Summary using the same table numbers assigned in Section IV. This should eliminate any confusion caused by the same table's having different numbers.

# BAY REGION CHARACTERISTICS

## A. BOUNDARIES AND COMPOSITION

### 1. Geographical Setting

Situated on the central California coast, the San Francisco Bay Region comprises one of the west coast's major urban/industrial centers (see Figure 1). The unique configuration of the Bay makes it a superb natural harbor. This feature, combined with the pleasant, moderate climate, resulted in the early settlement of the region by the first immigrants, the Spanish, and its rapid development.

The regional study area includes all or portions of the counties of Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo, and San Francisco. County boundaries are shown in Figure 2. The subregional boundaries, also shown in Figure 2, result from a series of water quality management plans, discussed in Reference 1, and generally reflect existing wastewater treatment districts.

### 2. Topography

The topography of the San Francisco Bay Basin (Figure 5) is dominated by the California Coast Ranges, a number of parallel ranges averaging about 50 miles in width and trending northwest to southeast. In the west the Coast Ranges rise abruptly from the sea, in many places notched by a series of wave-cut terraces, the highest ones more than 1,500 feet above sea level and one to two miles wide.

In the South Bay, the Santa Clara Valley extends northwesterly throughout the subregion, and is flanked on either side by complex ridges with rugged slopes varying from 20 to 60 percent.

The San Mateo subregion is dominated by the Santa Cruz Mountains in the east and the flat-lying artificial Bay fill in the west. The steep hillsides in the Santa Cruz Mountains are very susceptible to landsliding, and many structurally damaging slides have occurred in this region in historic times (Reference 2).

San Francisco's topography has resulted primarily from erosion of a lithologically complex terrain and from deposition of sand dunes. The rolling terrain of Golden Gate Park and the moderate slopes in the central part of the city are due to weathering and subsidence of tremendous quantities of dune sand (Reference 3).

The Marin-Sonoma subregion displays the typical topography of the Coast Ranges, with gently rolling foothills and rugged, sharply dissected ridges at higher elevations. The intermountain valleys,

Petaluma and Sonoma Valleys, consist of coalescing alluvial fans and floodplains and are among the largest valleys in the study area.

The mountain valleys of the Napa-Solano subregion are generally steep and are very susceptible to downslope movement of debris. The tidal areas and Delta region bordering Suisun Bay and Carquinez Strait occupy a large portion of the subregion and are used primarily for agriculture and grazing.

The Contra Costa subregion is dominated by the Diablo Range, consisting of smooth rolling hills to farily rugged mountains. The San Francisco Bay depression and intermountain valleys are nearly level floodplains and low terraces.

The Livermore-Amador subregion lies within the Diablo Range. Most mountain valleys are young and V-shaped. South of Livermore Valley, the slopes are steep and the ridges narrow. The upland terraces south of Livermore Valley are characterized by smooth, wide ranges that dip at an angle of 10 to 30 degrees northward, and by steep V-shaped valleys. The intermountain valleys are coalescing alluvial fans, low terraces, and floodplains. The adjoining Livermore and Amador Valleys are the largest of the coastal valleys.

The East Bay subregion consists of two general physiographic regions: the Berkeley Hills and the Bay fill area. The Berkeley Hills are fairly steep hills with rounded ridges. Most mountain valleys are young and V-shaped. On the eastern flank of the hills landslides are very common, especially within the Orinda Formation, which consists of silt, clay, and sometimes sand and gravel. The western part of the East Bay subregion is the filled San Francisco Bay depression.

## B. ENVIRONMENTAL, SOCIAL, AND ECONOMIC SETTING

### 1. Physical Environment

a. Geology. The San Francisco Bay Region contains most of the geologic units present in the California Coast Ranges. These units have been folded and faulted into structures that are also typical of the Coast Ranges as a whole. Many rock types are represented, varying in lithology and in age. The oldest formation outcropping in the area is the Franciscan Formation, Jurassic in age (170 million years); the youngest rocks are Quaternary sediments (three million years or less).

The Franciscan Formation outcrops extensively in the Diablo Range of Santa Clara and Alameda Counties; exposures can also be found in the Santa Cruz Mountains west of Santa Clara Valley and south of San Jose, on the San Franciscan Peninsula east of the San Andreas fault zone, along the base of the Berkeley Hills, in the Mount

Diablo area, over most of Marin and Sonoma Counties, and in scattered parts of Napa County (Reference 4).

The Great Valley Sequence overlies the Franciscan Formation in places and is exposed primarily in the eastern part of the Bay Basin.

Unconsolidated sediments are primarily Late Pliocene (ten million years) to Holocene, and form the valley floors and the Bay muds in San Francisco (Reference 5). The thickness of the sediments varies from place to place; the broader valleys generally contain the thickest deposits. The centers of the Santa Clara, Livermore, and San Joaquin Valleys are more than 1,000 feet thick and up to 3,000 feet thick in some places.

b. Seismic History. The nine Bay Area counties lie within a geologically active, young, dynamic part of the California Coast Ranges, one of the most seismically-active areas in the United States. The major active fault zones recognized in the Bay Region are the San Andreas, the Hayward, and the Calaveras (Reference 6).

Figure 5 shows the location of the active fault zones, all trending northwesterly. The San Andreas fault zone is near the western border of the Bay Region. Seismic activity along the fault is manifested by earthquakes varying in magnitude from 8.25 (the 1906 San Francisco earthquake) to about 5 on the Richter scale. In the East Bay, the Hayward fault zone is about 20 miles east of and nearly parallel to the San Andreas fault zone, and extends southeast from San Pablo Bay to Warm Springs. Its location northwest of San Pablo and southeast of Warm Springs is not definitely known. Recent evidence shows that tectonic creep has been occurring along this fault at a rate of one-half foot per 50 years since 1920. The Calaveras fault, a wide and complex zone, lies generally east of the Hayward fault zone, but may merge with it near or south of Calaveras Reservoir, and may join the San Andreas fault zone ten to fifteen miles southeast of Hollister. The Calaveras fault has not shown evidence of earthquake activity in recent history, but tectonic creep has been observed, especially near its southern end.

The Bay Basin accommodates a number of inactive faults (i.e., faults not active within the last 10,000 years); however, there is no reason to anticipate a reactivation of these dormant faults, and they are not considered as a potential hazard.

c. Climate. The climate along the central California coast near San Francisco Bay is characterized by mild temperatures throughout the year, with small diurnal and annual ranges near the ocean and larger ranges further inland. Rainfall is concentrated in the period of November through April, which accounts for about 90 percent of the annual total. Winds are generally onshore, from the west through north, and are modified locally by terrain

features. Severe weather is rare, usually occurring in the winter months in conjunction with frontal passage bringing high winds and heavy precipitation.

The center of the San Francisco Bay Area is a large, shallow basin ringed with hills that taper into a series of sheltered valleys (such as the Santa Clara, Livermore, Diablo, and Napa Valleys). This topography alone gives the area great potential for trapping and accumulating air pollutants. Within this basin contaminants are emitted at a fairly constant rate throughout the year. Pollution concentrations fluctuate widely from day to day and from season to season because of the weather.

Global-scale weather strongly affects these local variations. When strong jet-stream winds dominate the airflow above California, or when migratory storms bring rain and upward vertical flow, air pollution concentrations are low. When high-pressure areas dominate California, resulting in light winds and downward vertical flow, heavy buildups of pollution are common. The amount of air available to dilute pollutants depends primarily on two factors, horizontal airflow and vertical mixing.

Vertical mixing is severely limited when a layer of warmer air lies above a layer of cooler air. This reversal of the atmosphere's normal decrease of temperature with altitude is called an inversion. The strong inversions typical of California summers are caused by downward vertical motion, called subsidence, which compresses and heats the air. The surface inversions typical of winter are formed by radiation as air is cooled in contact with the earth's cold surface at night. Both types of inversion mechanisms may operate at any time of the year; in autumn, both often combine to produce heavy pollution.

This important effect of a temperature inversion is to prevent pollutants from rising and being diluted vertically. Summer subsidence inversions persist throughout the day and occur more than 90 percent of the time. Winter radiation inversions occur on more than 70 percent of the nights but are usually destroyed by heating in the afternoon, bringing rapid improvement in air quality (Reference 7).

d. <u>Soils and Agricultural Capabilities</u>. Bay Region soils may be classed into three major categories: residual, inland valley, and recent alluvial (Reference 1).

Residual soils are those that have formed in place on consolidated bedrock through the processes of mechanical and chemical weatering. These soils, generally occurring on the steeper slopes throughout the region, tend to be shallow, are particularly susceptible to erosion, and are not practical for agricultural purposes.

Inland valley soils are fairly old, deposited soils with moderately- to highly-developed profiles. They have been subjected to

elevation and later stream erosion, resulting in a characteristically rolling topography. Inland valley soils are generally well suited to cultivation.

Recent alluvial soils are found on floodplains, near stream channels, and on intertidal areas adjoining the Bay. Because these soils are still in a dynamic state, their profiles tend to be in the early stages of development. Soils in regions directly adjoining the coast are of low permeability, being composed of clay, clayey loam, and silt. The more inland alluvial soils generally have a higher permeability and are frequently used for commercial crop production.

Soils capable of agricultural production are shown in Figure 7. The soils are shown outside intensively-developed (urban) land areas and range in quality from those with few limitations to those with characteristics restricting the choice of crops that may be cultivated. Not shown are soils with major to very severe limitations restricting their use largely to grazing, woodland, or wildlife food and cover. Agricultural soils are generally moderately to very deep, are nearly level to strongly sloping, and vary from well-drained loams to poorly-drained saline soils. The following descriptions apply to agricultural soils where crops are known to be produced commercially.

The areas immediately bordering the southern portion of the Bay contain fine-textured soils, influenced primarily by tidal waters. Moving inland, the region consists of deep, poorly-drained soils of recent alluvial deposit. Most of the remaining South Bay valley floor, drained by Coyote Creek and the Guadalupe River, is formed from moderately-drained, medium-textured alluvial plain soils. These are the major agricultural soils in the subregion and support extensive orchards. A less extensive soil group, composed of older alluvial fans and terraces, is found between the major valley floor area and the more mountainous regions to the west, which contain residual soils formed in place from the underlying bedrock.

In most of the San Mateo subregion, shallow, well-drained residual soils predominate. Clayey, tidally-dominated soils of low permeability and poor drainage characteristics border the Bay. Some areas along the Pacific Ocean, particularly near Half Moon Bay, have a gentler topography, and the consequently deeper soils support some farming and extensive horticultural activity.

A wide diversity of soil types occurs within the Marin-South Sonoma subregion. As with other subregions, lands bordering the Bay are predominantly fine-grained alluvial soils somewhat influenced by tides. The Petaluma River and Sonoma Creek are major drainage basins, and surrounding alluvial soils support a variety of agricultural and dairy activities.

Napa County is characterized by a number of major valleys separated by intervening ridges, resulting in rich alluvial soils in the

drainage basins and shallower residual soils on the hillsides. The eastern portion of the subregion is covered by clayey tidal flats, usually water-saturated and of very low permeability.

The western and northern sections of the Contra Costa subregion bordering San Francisco, San Pablo, and Suisun Bays are dominated by tidal flats and mud, often saturated and poorly drained. Much of the soil in western Contra Costa County is clayey loam, suitable for agricultural or pasture use, although major portions have been covered by urban growth. Prime agricultural soils, mostly shallow loams and clayey loams, are found in eastern Contra Costa County.

The Livermore and Amador Valleys cover a small area in the northern portion of the Livermore-Amador subregion where the valley alluvial clayey loams support vineyards.

Three major soil groups, roughly forming three north-south strips, cover the East Bay subregion. On the western side, abutting the Bay, tidal flats and near-shore areas are represented by clayey and fine-grained soils of slow to moderate permeability. Further inland is a strip of deep clayey loams with moderate permeability. This grades into the eastern strip of soil covering the Pleasanton, Sunol, and Walpert Ridges. This is a moderately permeable clayey loam tending to be shallower than the soil to its west due to its higher erodibility.

e. Mineral Resources. The major resources recovered in the Bay Area are construction materials, such as limestone and oyster shells (used in the manufacture of cement), sand and gravel, and crushed stone; energy sources, such as gas, oil, and geothermal power; and salines (Reference 8). These commodities account for more than 90 percent of the Bay Area's mineral products. Virtually all are used within the Bay Area. In contrast, most of the mercury recovered from Bay Area ores has been exported.

Several mineral products that were recovered earlier will probably not be produced again in the near future, chiefly because of changed economics and greater availability elsewhere. In this category are asbestos, chromite, coal, copper, magnesite, manganese, and pyrite.

f. Hydrology. (The principal oceanic, estuarine, and inland surface water resources are shown in Figure 4.) The Pacific Ocean forms the western boundary of the San Francisco Bay basin and directly affects the San Mateo, San Francisco, and Marin-Sonoma subregions.

The San Francisco Bay system forms one of the world's major estuaries (Reference 9). The Bay at mean tide currently includes an area of about 435 square miles.

The Sacramento-San Joaquin Delta has a major effect on the hydrology of San Francisco Bay. More than 1,100 square miles in area, the Delta is roughly triangular, extending from Chipps Island near Pittsburg on the west, north to Sacramento, and south to a point about ten miles southeast of Tracy. The average annual outflow is about 18 million acre-feet.

The Delta, at the eastern end of Suisun Bay, is the entry point of the Sacramento and San Joaquin Rivers into the Bay system and contributes virtually all of the fresh-water inflow to San Francisco Bay. The Basin contains many small streams. Characteristically, these are highly seasonal in flow; more than 90 percent of the average flow occurs during winter, and many of the smaller streams dry up in late summer.

The net horizontal movement of ground water through the entire Bay system is affected by exchanges with fresh water in aquifers adjacent to the bays. Nine distinct ground-water basins are recognized and are shown in Figure 4.

The quality of the ground water in the study area is generally good to excellent, especially around Suisun Bay and Marin-Sonoma. The South Bay has experienced problems with overdrafting the ground water, resulting in saline water intrusions, land subsidence, and lowering of the ground-water table.

In southern Santa Clara Valley, continental deposits overlain with alluvial deposits form two major aquifers. The ground-water basin in northern Santa Clara valley has been subjected to serious overdraft beginning in the 1930s, resulting in ground subsidence, saline water intrusion around the Bay, and gradual deterioration of ground-water quality in parts of the basin. The Santa Clara Valley Water District has undertaken such mitigating measures as water recharge programs, which have resulted in a small rise in the water table in recent years (Reference 10).

The eastern part of the San Mateo subregion is part of the Santa Clara Valley ground-water basin. The western part of the subregion has no large underground storage basin. Most of the wells yield only 15 to 100 gallons per minute. In some places the water is too saline for agricultural use; however, water supply is sufficient for domestic and livestock use in this area.

The principal Marin-Sonoma aquifers occur in the alluvial plains in Petaluma and Sonoma Valleys. It appears to continue southward below San Pablo Bay, where it is covered by relatively impermeable layers of clay and mud. This aquifer reaches from San Pablo Bay north to one mile south of Glen Ellen.

Water from the Petaluma Valley ground-water basin is generally a calcium bicarbonate type of good quality. High salinities in the southern part of the basin appear to result from downward movement

of shallow brackish waters rather than from intrusions of water from the Bay. Sonoma Valley ground water is generally a sodium bicarbonate or sodium chloride type and is satisfactory for most uses.

The principal aquifers in the Napa Valley basin are of the same nature as those in Sonoma Valley. The aquifers of the southern part of the Napa-Solano subregion are of old alluvial and continental deposits underlying the alluvial plans of the Fairfield and Green Valleys.

The ground-water quality in Napa Valley is similar to that in Sonoma Valley. The Suisun-Fairfield Valley basin's water is generally hard, slightly alkaline, and of either calcium or sodium bicarbonate type; it is suitable for most uses (Reference 6).

In the northern part of the Contra Costa subregion near Suisun Bay, layered deposits of sand and gravel separated by thick layers of silt and clay form an aquifer having a base depth of less than 200 feet and a general bayward dip. A part of this aquifer is exposed directly to the Sacramento River.

The Tehama Formation of semiconsolidated continental sedimentary rocks outcropping in the foothills along the south shore of Suisun Bay might constitute an aquifer. The general movement of ground water in this region is bayward; the aquifers are recharged by upland percolation of precipitation.

Excessive industrial and municipal ground-water overdrafts in the past have induced infiltration of lower-quality waters from the adjacent river. Ground water underlying the Pittsburg Plain is no longer used due to poor mineral quality; water from Clayton Valley aquifers are of generally good to excellent quality for irrigation although, because of excessive hardness they are usually softened for domestic and some industrial uses. Ground water underlying Ygnacio Valley is of generally poor quality, and its use has declined since construction of the Contra Costa Canal.

The Livermore Valley principal basin aquifers cover about 170 square miles. Portions of the basin have been overpumped for many years. Water for recharge imported from the South Bay Aqueduct has improved the water quality and raised the ground-water levels in some areas in recent years.

Three distinct aquifers occur in the East Bay, extending from Irvington in the south to the San Leandro-San Lorenzo area in the north. Each aquifer is separated from the others by impermeable blue clay layers; all are wedge-shaped, being relatively thick inland and tapering off toward the Bay.

The Alameda County Water District operates recharge basins in gravel pits to percolate natural runoff and imported water from Alameda Creek into the ground-water basin. This program has

resulted in the maintenance of existing water quality, a rise in ground-water levels in the upper parts of the basin, and a possible decrease in the rate of saline water intrusion into the lower reaches adjacent to the Bay.

g. Flood Potential. The possible flooding of lands adjacent to the Pacific Ocean, San Francisco Bay, and the streams and rivers in the Bay basin represents a hazard to any sludge management process located on these floodplains. The location of sludge disposal sites, including landfills and dedicated land sites in known floodplains, would be of primary concern. The U.S. Department of Housing and Urban Development discourages certain types of development on areas within the 100-year floodplain; these areas are shown in Figure 4 (Reference 11). Current State requirements stipulate that landfill disposal sites must be protected from the 100-year flood (Reference 12). Legislation does not affect the agricultural use of floodplains; indeed, much of the region's prime agricultural land occurs on floodplains as a result of fluvial activity.

h. Noise. Noise has become an increasingly important problem in the Bay Area as population, urbanization, and transportation systems have grown. Noise levels are generally determined by density of development and distance to transportation facilities or industrial sites. Thus sparsely developed and rural areas have the lowest levels, and the highest levels obtain in the highly-urbanized population centers. Typical sound levels of various common noise sources are shown in Table 2.

There is no regional agency for noise control in the Bay Area. There are Federal and State regulations on noise from specific sources such as airports and highways. Most cities and counties have developed individual noise control strategies, usually embodied in local ordinances or general plans. Noise standards are not uniform, and the enforcement and effectiveness of local noise controls vary.

These noise control strategies fall into two major categories. Qualitative noise controls do not specify unacceptable noise levels but require abatement of specific noise sources that cause complaints from citizens. Quantitative noise controls specify maximum noise exposures for different land uses. Often these levels are used as goals or planning guidelines, with no legal basis for their enforcement.

The California Occupational Safety and Health Act of 1973 limits the noise exposure of employees at commercial and industrial sites. It also requires that any new facility be built with all feasible noise control measures to reduce noise below the noise exposure limits set by the Act. If such controls fail to reduce sound levels below these limits, personal protective equipment such as ear plugs

TABLE 2
TYPICAL SOUND LEVELS MEASURED
IN THE ENVIRONMENT AND IN INDUSTRY[1]

| | Decibels, A-Weighted | |
|---|---|---|
| Civil Defense Siren (100')[2] | 140 | |
| Jet Takeoff (200') | 130 | |
| | 120 | |
| Riveting Machine | 110 | Rock Music Band |
| Emergency Engine-Generator (6')<br>DC-10 Flyover (700') | 100 | Pile Driver (50') |
| Textile Weaving Plant<br>Subway Train (20') | 90 | Boiler Room<br>Printing Press Plant |
| Pneumatic Drill (50') | 80 | Garbage Disposal in Home (3')<br>Inside Sport Car, 50 mph |
| Freight Train (100')<br>Vacuum Cleaner (10')<br>Speech (1') | 70 | |
| | 60 | Auto Traffic Near Freeway<br>Large Store<br>Accounting Office |
| Large Transformer (200') | 50 | Private Business Office<br>Light Traffic (100')<br>Average Residence |
| | 40 | Minimum Levels, Residential Areas |
| Soft Whisper (5') | 30 | |
| Rustling Leaves | 20 | Recording Studio |
| | 10 | |
| Threshold of Hearing in Youths (1,000-4,000 Hz) | 0 | |

[1]Adapted from Reference 14, p.9.

[2]The distance (in feet) between the source and listener is shown in parentheses.

must be provided to employees. The permissible noise exposures are shown in Table 3.

## 2. Biotic Environment

a. Flora and Fauna. In selecting sites suitable for use in wastewater solids management, consideration must be given to existing vegetation as well as potential natural vegetation that will develop if human influences are removed. The natural vegetation of the San Francisco Bay Region can be categorized as follows (Reference 13):

Grasslands
- 1) California Steppe (*Stipa*, perennial grass)
- 2) Tule marshes (*Scirpus*, *Typha* - rushes, cattails)
- 3) Fescue oatgrass (*Festuca* - fescue)

Shrub habitats
- 4) Coastal sagebrush (*Salvia*, *Eriogonum* - sage)
- 5) Chaparral (*Ceanothus* - deer brush)

Needleleaf (coniferous) forest
- 6) Redwood forest (*Sequoia*, *Pseudotsuga* - redwood, fir)

Broadleaf and needleleaf forest
- 7) California mixed evergreen (*Quercus*, *Arbutus*, *Pseudotsuga* - oak, madrone, fir)
- 8) California oakwoods (*Quercus* - oak)

Today the classifications of vegetative type are virtually the same. With the exception of the grasslands (which are now dominated by annual rather than perennial species), most of the ecosystems still maintain the same dominant species. Figure 6 portrays the existing vegetative habitats. In comparing these to the potential vegetation categories, tule marshes are comparable to marshland and California steppe is referred to as grassland. Coastal sagebrush is considered under chaparral, and mixed evergreen and oaklands are shown as hardwood forests. New categories are barren, cultivated/pasture, and urban/industrial.

In general, coniferous forests are found only along the north- and west-facing slopes on the western side of the Coastal Ranges or in moist fog-laden valleys in Marin and San Mateo Counties. Oak forests include laurel, buckeye, and madrone trees and are frequently interspersed with grasslands. Along streams, alders, willows, and sycamores predominate. Chaparral occurs on poor soils, mixed with oak forests, and on dry hillsides. Inland from the hills surrounding the Bay and on coastal terraces near the Bay, the land forms are dominated by extensive grasslands, most of which are extensively grazed.

Wastewater solids management activities will be essentially confined to terrestrial sites not adjoining wetland areas. The common species of animals most likely to be affected by these activities are black-tailed deer, which range throughout the Bay Area;

TABLE 3
PERMISSIBLE NOISE EXPOSURES SET BY THE
CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH
ACT OF 1973

| Duration Per Day Hours | Sound Level A-Weighted Decibels |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1½ | 102 |
| 1 | 105 |
| ½ | 110 |
| ¼ or less | 115 |

Source: Reference 15.

small upland mammals such as cottontail, brush rabbit, jack-rabbit, and western gray squirrel, which are plentiful throughout the foothills and woodlands; California quail and mourning dove, the chief upland game birds of the Bay Area; and more than 100 species of songbirds occupying various habitats. Other, less common, upland fur-bearers include the coyote, gray fox, badger, skunk, opposum, weasel, and bobcat.

Many species of amphibians and reptiles inhabit the Bay Region, including frogs, toads, and salamanders, which require permanent fresh-water habitat. Other common species are the California newt, California slender salamander, western toad, western fence lizard, gopher snake, common king snake, and several species of racer.

Figure 6 shows the locations of wildlife refuges and preserves.

b. Endangered Species. The California Native Plant Society's listing of rare and endangered plants (Reference 16) includes a large number of species found throughout much of the study area. Many of htese plants are wetland related and therefore should not receive direct impact from the Wastewater Solids Study. In the course of evaluating each proposed site, any rare or endangered plant that could be affected by the project will be identified.

Table 4 lists rare and endangered species that could be affected by wastewater solids management practices in the Bay Area. Species listed may occur on terrestrial sites and are accorded varying degrees of protection depending on their status (References 17 and 18). Federal funding could be curtailed for projects having significant adverse impacts on habitat known to be used by species listed as threatened (Reference 17). Habitats used by species listed as rare or fully protected (Reference 18) should be avoided.

c. Sensitive Ecological Areas. Within the Wastewater Solids Study planning area, some parcels of land contain assemblages of plants, animals, and physical features that set them apart. Most of these areas retain their original natural values much as they have existed for centuries. Because of the interrelationships among the waters, soils, plants, and animals, disturbances to any one element can cause changes in other elements that depend directly or indirectly on the affected element. Because of these unique assemblages and dependencies, such areas are considered to be ecologically sensitive. More than other areas, they are susceptible to adverse impacts from changes in land use.

Sensitive ecological areas are associated primarily with coastal areas, wetlands, and streams (Figure 6). For the purpose of this study, wildlife preserves and refuges and critical habitat for endangered species are also considered to be ecologically sensitive.

TABLE 4
RARE AND ENDANGERED SPECIES
IN THE SAN FRANCISCO BAY AREA

| Common Name | Scientific Name | Reference 8 | 11 | 5 | 4 |
|---|---|---|---|---|---|
| Birds | | | | | |
| Prairie falcon | Falco mexicanus | | T | | |
| American peregrine falcon | Falco peregrinus anatum | E | T | E | F |
| In addition, all shorebirds are protected. | | | | | |
| Reptiles | | | | | |
| Alameda striped racer | Masticophis lateralis euryxanthus | | | R | |
| San Francisco garter snake | Thamnophis sirtalis tetrataenia | E | T | E | F |

T = Threatened  R = Rare
E = Endangered  F = Fully protected

Source: Reference 1.

## 3. Human Environment

a. Economic Activity. The largest single feature of the region's economy is the combined economic effect of all the individual service activities associated with a large urbanized area.

Manufacturing ranks second in the economy of the Bay Area and until recently was substantially diversified, tending toward light industry, development of the state's natural resources, and the financial and commercial activities of regional urban centers. This balance has been altered in recent years with the addition of defense-oriented manufacturing plants in the southern part of the region.

Recent industrial growth around the Bay has included oil refineries, explosives manufacture, food processing and packaging plants, a highly-developed construction materials industry, and the manufacture and fabrication of a variety of other products. The outlying portions of the region are under intensive agricultural development, following the general pattern of the interior valleys of the state.

To provide the input essential in forecasting waste generation in the 1975 Water Quality Control Board Study, the Regional Water Quality Control Board modified the basic data supplied by ABAG. Although the total employment for the nine-county area was retained, the distribution of employment was shifted to reflect more reasonable commuting time for workers. The approach for this revised allocation was based on the planning work of the Bay Area Transportation Study Commission. In effect, this shift in employment distribution causes greater increases in employment for the northern counties of Solano, Sonoma, Napa, and Marin. This difference is balanced largely by lower growth rates in employment for both Alameda and Santa Clara counties.

The second revision to the basic data, which is more closely related to the capacity for waste generation, occurs in the allocation of employment between basic and population-serving classifications of employment. Wastes generated by basic industries differ significantly in magnitude and character from municipal wastes. Population-serving employment is determined by subtracting the total number of employees involved in manufacturing from the total employment figures supplied by ABAG.

Further adjustments were made to exclude sales and office personnel from the manufacturing categories. The resulting 1970 employment distribution by county, which serves as the 1970 base line for projecting employment in the area, is presented in Table 5. The basic employment figure includes only the number of workers engaged in actual production. The 1975 employment figure was developed by ABAG and is also shown in Table 5.

b. Housing Supply. Housing factors relating to wastewater solids management include the possible effects any management plan

TABLE 5

BASE-LINE EMPLOYMENT DISTRIBUTION, 1970, 1975

| County | 1970 | | | 1975 | | |
|---|---|---|---|---|---|---|
| | Population-Serving | Basic | Total | Population-Serving | Basic | Total |
| Alameda | 356,274 | 101,173 | 457,447 | 224,162 | 210,107 | 434,270 |
| Contra Costa | 112,394 | 24,527 | 136,921 | 102,385 | 57,672 | 160,057 |
| Marin | 47,120 | 3,577 | 50,697 | 39,882 | 15,846 | 55,728 |
| Napa | 23,144 | 2,473 | 25,617 | 18,685 | 9,945 | 28,630 |
| San Francisco | 440,849 | 57,632 | 498,481 | 260,052 | 235,354 | 495,406 |
| San Mateo | 185,949 | 30,367 | 216,316 | 119,449 | 105,681 | 225,130 |
| Santa Clara | 297,729 | 120,995 | 418,724 | 254,869 | 262,881 | 517,750 |
| Solano | 39,378 | 3,358 | 42,736 | 27,582 | 24,711 | 52,293 |
| Sonoma | 12,398 | 1,658 | 14,056 | 48,225 | 29,069 | 77,294 |
| Total | 1,515,235 | 345,760 | 1,860,998 | 1,095,292 | 951,266 | 2,046,558 |

Source: References 1 and 19.

would have on the supply and demand for housing; the types of plumbing facilities in existing housing (running water, toilets, septic tanks, etc.); and the effect of a treatment of disposal facility on the quality of housing nearby.

In the past decade, more than a million and a half people have moved into the Bay Area, a population increase of over 20 percent. The existing housing stock in the nine counties cannot accommodate the demand for new housing, and all counties are feeling the pressure to increase the housing supply. Between 1970 and 1975, Alameda County increased its number of units from 365,000 to 403,000; Contra Costa County from 172,950 to 204,600; and San Mateo County from 185,000 to 209,300 (Reference 20). The number of units in San Francisco, however, decreased from 295,200 to 293,300, due to redevelopment and the abandonment of inadequate units.

c. Health and Safety. For the purposes of this task report, health and safety aspects are defined as health hazards emanating from heavy metals, persistent organic compounds, and microbiological contaminants. Health problems related to air and water pollution are important enough to warrant separate consideration and are discussed in the sections on air quality and water quality.

d. Sense of Community. For the purposes of the Wastewater Solids Study, the discussion of community character will review the more common indicators, which can be measured and compared from one area to another.

The enormous expansion of most Bay Area communities over the last two decades and the relatively short time over half the residents have lived in their particular dwelling (owned or rented) may have ramifications for the long-range planning of waste disposal. Four demographic indicators that can be considered as contributing to a sense of community are population (discussed in a separate section above), education, family income, and employment.

All residents of the nine-county area appear to place a premium on education. More than 60 percent of the population have completed high school, and almost 10 percent have four years or more in college. The median education for people 25 years or older, the percentage who completed high school, and the percentage who had at least four years of college are outlined in Reference 16.

Table 6 shows the ranking of family income within the nine counties, the percentage below the poverty level, and the percentage earning more than $15,000.

Table 7 shows the rank of unemployment within the counties. The nation's economic recession was felt in the Bay Area, and unemployment rates have increased annually in all counties for the

TABLE 6
FAMILY AND PERSONAL INCOME, 1970

| County | Rank of Family Income for Study Area | % Below Poverty Level | % Above $15,000 | Rank of Net Personal Income for Study Area |
|---|---|---|---|---|
| Alameda | 5 | 8 | 28 | 4 |
| Contra Costa | 4 | 6 | 35 | 6 |
| Marin | 1 | 5 | 44 | 3 |
| Napa | 6 | 8 | 24 | 9 |
| San Francisco | 7 | 10 | 27 | 1 |
| San Mateo | 2 | 4 | 39 | 2 |
| Santa Clara | 3 | 6 | 35 | 5 |
| Solano | 9 | 9 | 20 | 7 |
| Sonoma | 8 | 10 | 20 | 8 |

Source: Reference 21.

TABLE 7
UNEMPLOYMENT

| County | Rank-Highest Unemployment Percentage |
|---|---|
| Alameda | 3 |
| Contra Costa | 6 |
| Marin | 8 |
| Napa | 7 |
| San Francisco | 4 |
| San Mateo | 9 |
| Santa Clara | 5 |
| Solano | 1 |
| Sonoma | 2 |

Source: Reference 22.

last five years. Solano and Sonoma Counties had the highest unemployment percentages; their bordering county, Napa, had one of the lowest. Marin and San Mateo Counties, with the highest family income, had the lowest percentage of unemployment.

e. Equity. From the economic perspective, equity can be measured in terms of the costs and benefits of a particular program/service to the consumer. The concept of equity applied to social science research generally refers to the opportunities available to the population to enhance their quality of life.

All nine counties of the Bay Area are subject to a multitude of Federal, State, and County regulations on equal employment opportunities, social services for special populations groups, and anti-discrimination practices. Yet unemployment is higher in the nine counties than the average for the rest of the country. Critical social services have been curtailed due to a cutback of public funds, and continued pressure is exerted at the local, county, State, and Federal levels to expand old programs and develop new ones for increasing the educational and employment opportunities for all segments of society in the Bay Area.

The public is concerned about improving the level of equity in the nine counties. School bond issues to expand educational facilities are on nearly every election ballot. Elected officials claim that alleviation of unemployment is a top priority.

In developing a regional wastewater solids plan, the impact on individual opportunity is an area of critical interest. Any project proposed by the plan should have provisions to insure equal employment opportunities for all population groups. The process of selecting disposal/use options should include an examination of the relative cost/benefit (i.e., level of consumer surplus) to insure that the most "equitable" method available to the public is implemented.

## 4. Historic and Archaeological Setting

There is no central repository for the registered historic and archaeological sites found in the Bay Area. Rather, the sites are designated by a variety of local, municipal, county, academic, State, and Federal groups and agencies, including:

Federal: National Register of Historic Places

State: Historical Landmarks Advisory Committee
Department of Parks and Recreation, Office of Historic Preservation

County: Alameda County Planning
San Francisco Landmarks Board

Marin Heritage
Santa Clara County Landmark Program
Napa Architectural Heritage
Napa Redevelopment Agency
Sonoma League for Historic Preservation
Contra Costa County Planning Department

Local: Livermore Heritage Guild
Napa Community Redevelopment Agency
San Francisco Heritage
Berkeley Landmark Board
Berkeley Architectural Heritage Association

Archaeological sites are listed in regional clearing houses located at the following academic institutions:

San Francisco State College
Aptos College
Sonoma State College
Cabrillo College
University of California, Davis

Known historic and archaeological sites in the study area have been identified; their general locations are shown in Figure 7.

## 5. Visual Amenities

Visual amenities may be categorized as coastal viewshed, highly scenic areas, and open areas with particular value in providing contrast to urbanization or in preserving natural land forms.

Included in the coastal viewshed are coastal lands and waters that can be seen from coastal highways and access roads, trails, railroads, public vista points, recreation areas, the water's edge. These subcategories can also be used for evaluating the visual amenities of the Bay. Highly scenic areas include ridges, oak woodland and redwood concentrations, agricultural valleys, and landscape preservation projects. Open areas are particularly valuable in the heavily urbanized San Francisco Bay Region. These open-space areas are important resources and must be balanced with development.

## 6. Energy

Most of the electricity and natural gas used in the San Francisco Bay Region is supplied by Pacific Gas and Electric Company (PG&E). PG&E generates electricity from a variety of sources: hydroelectric, pump storage, fossil fuel, nuclear, and geothermal.

To meet the anticipated increased demand for electricity in Northern California, PG&E proposes to increase its electrical capacity by some 66 percent over the ten-year time period through 1975-1985.

The major changes involved in PG&E's proposed system increments are a drastic change from reliance on hydroelectric power, a large decrease in reliance on straight fossil-thermal plants, a large increase in reliance on nuclear power, and an increase in the number of geothermal power plants.

All of the electricity for the Bay Area, including NCPA power, is brought in by PG&E transmission lines.

Natural gas is supplied to the Bay Area by PG&E. To offset decreasing natural gas supplies, California utilities propose the following supplementary supplies: liquefied natural gas from Alaska and Indonesia, synthetic natural gas from coal in the Four Corners area, North Alaska gas, and pipeline deliveries (intrastate, interstate, and foreign sources). The above supplemental supply schemes are not definite. They are technically and financially risky, costly, and capital intensive and require action, changes, and approvals by governmental bodies.

## C. POPULATION TRENDS

### 1. Population Distribution

Table 8 shows the total population of the study area in 1975. Santa Clara and Alameda Counties contain 48.2 percent of the area's population. San Francisco, Contra Costa, and San Mateo Counties each contain about an eighth of the total; however, they differ widely in concentration of population. San Francisco is highly urbanized with little potential for population growth, while large portions of Contra Costa and San Mateo are undeveloped. Marin, Solano, Sonoma, and Napa Counties each contain five percent or less of the total population and are comparatively suburban and rural in character.

### 2. Population Projections and Growth

Table 8 also shows the population projections for the study area for the period 1980-2020. The ABAG Series 3 Projections (Reference 16), used as a base for the Environmental Management Plan, project population, housing, employment, and land use in the Bay Region to the year 1990. The California Department of Finance E-O projections (Reference 19) are indicated as required by the State Air Resources Board for the review of Clean Water Grant Projects. Population growth must be compared to these figures in critical air areas. The San Francisco Bay Region is identified as a critical air basin. The ABAG and Department of Finance E-O projections differ in the fertility rate, in-migration rates, and population base. The E-O series assumes a future level of fertility of 2.1 children per female (equivalent to zero population growth); the ABAG series assumes a fertility rate range of 1.8 (high projections) to 1.5 children per woman (low projections). County projections are indicated when available.

In the period 1975 to 1990 (based on the ABAG projections), populations in Napa-Solano and the Livermore-Amador Valley will increase over 40 percent. Contra Costa and Marin-Sonoma populations will increase 32 and 29 percent, respectively. The South Bay will have a population increase of 10 percent, San Mateo and the East Bay subregions less than 3 percent, and San Francisco population will decrease by 5 percent.

Over the long range, 1975-2020 (based on Department of Finance projections), Marin-Sonoma and the Livermore-Amador Valley subregions will experience more than 50 percent growth. Contra Costa will experience a growth rate of 46 percent, the South Bay subregion 31 percent, Napa-Solano and the East Bay 11 percent, and San Mateo 5 percent. In terms of absolute growth, the South Bay subregion will experience the largest increase in persons. The Contra Costa subregion, the Napa-Solano subregion, and the Livermore-Amador Valley will experience rapid growth.

TABLE 8
PROJECTED POPULATION GROWTH
IN THE STUDY

| Subregion | Type of Projection | | | | | |
|---|---|---|---|---|---|---|
| | ABAG (high) | | | E-0 | | |
| | 1975 (persons) | 1990 (persons) | % change | 1975 (persons) | 2020 (persons) | % change |
| Marin-Sonoma | 256,300 | 330,654 | 29% | 265,600 | 408,520 | 54% |
| Napa-Solano | 209,300 | 297,350 | 42% | 264,800 | 304,300 | 15% |
| Contra Costa | 502,000 | 660,992 | 32% | 491,700 | 718,794 | 46% |
| East Bay | 1,018,300 | 1,050,630 | 3% | 1,098,700 | 1,223,900 | 11% |
| Livermore-Amador Valley | 107,400 | 154,100 | 43% | 107,900 | 168,606 | 56% |
| South Bay | 1,119,900 | 1,240,947 | 11% | 1,207,600 | 1,578,200 | 31% |
| San Mateo | 545,200 | 557,739 | 2% | 569,700 | 599,500 | 5% |
| San Francisco | 672,700 | 641,906 | - 5% | 669,000 | 564,200 | -16% |
| Total | 4,431,100 | 4,934,318 | | 4,675,000 | 5,566,020 | |

Source: References 16 and 19.

Population is expected to grow in areas where land is available for development; this will fill in undeveloped areas in the central couties of the study area (Alameda, Contra Costa, San Mateo). When land becomes unavailable for development, as in San Francisco, people will move to adjacent areas, and will continue to absorb vacant land near urbanized areas such as in the South Bay subregion.

## D. LAND USE MANAGEMENT

### 1. Present Urban Patterns and Land Use

Land use and special features are delineated in Figure 7. The Bay is almost entirely circled by a continuous band of intensively-developed land. This is land with building structures spaced 50 feet or less apart and includes commercial, residential, and dense industrial uses.

With the exception of parts of the northern shore, the development pattern starts at the Bay's edge and moves inland to the foothills Industries start the pattern next to the Bay, followed by freeways, businesses, and residential development. The larger inland urban areas have followed a concentric pattern built around a commercial-industrial center with high- and medium-density residential areas.

In terms of the concentration of business areas, employees, and residential densities, the urban cores of the region are the San Francisco-Oakland area and the development around San Jose. Outside of these highly-developed aeras are extensively-developed suburbs: the peninsula between San Francisco and San Jose, western Santa Clara County, southern Alameda County, central Contra Costa County and eastern Marin County.

Santa Rosa is the region's largest independent urban area located beyond the community ranges of the regional core; it has a relatively low-density development. The other large urban center in the region is Walnut Creek-Concord area of Contra Costa County. Twenty years ago it was predominantly rural in character; today an almost unbroken band of urban development extends from Orinda on the west and Martinez on the north to Danville on the south. The bulk of this new growth consists of low-density residential development.

The general changes in residential land use over the past twenty years have taken place primarily in the west side of the Santa Clara Valley, formerly scattered development; Southern Alameda County and parts of the Livermore Valley; Central Contra Costa County, which has expanded greatly; and Central Sonoma County, an increase of scattered low-density development.

Agriculture continues to be one of the region's largest land users; the basic pattern of cultivated land approximates the pattern of over twenty years ago, but less land is in cultivation. Urban

expansion has resulted in large changes throughout the region, notably in Santa Clara, Contra Costa, and Sonoma Counties. The construction of Lake Berryessa in Napa County also reduced agricultural acreage.

The cultivated agricultural areas in the region are the most vulnerable to intrusions of urban development, since both land uses seek the same type of conditions: best soils, level sites, and good climates. Virtually all urban expansion has moved into these types of areas. The noncultivated agriculture land in the region has been disturbed less than the areas under cultivation, primarily because it is hilly or gently rolling. These lands are used for grazing and are not easily developed for urban uses.

Open space has been developed for extensive industrial uses, such as the solar extraction of salt in the ponds surrounding the Bay in San Mateo, Santa Clara, and Alameda Counties of the South Bay, and in Napa and Solano Counties of the North Bay. Other open-space industrial uses include the natural gas fields in Rio Vista, the gravel pits in Pleasanton, and the bunkers of Hercules.

The least extensive open-space use has been for recreation. Parks, land, and water for recreation are randomly distributed throughout the region. Marin County has the largest amount of land set aside for recreation, including the Point Reyes National Seashore, the Marin Municipal Water District, and various areas under State control such as Angel Island (which may be transferred to the Golden Gate National Recreation Area). Other major recreational parks are those in the East Bay along the tops of the Berkeley-Oakland hills.

Table 9 lists the State, county, and regional parks and military installations shown on Figure 7.

The region's major employment centers are located along the Bay plain, the northern edge of Contra Costa County bordering Carquinez Strait, Suisun Bay, and the San Joaquin River. The bulk of new employment growth in the last 20 years has taken place in these same areas.

The general zoning pattern of the region is closely related to existing land use with two exceptions. First, in Santa Clara, Marin, Sonoma, and Napa Counties, agricultural districts permit residential development of parcels of less than five acres. Second, land zoned for industry in the region far exceeds present and probable future development needs, especially along the Bay from Hayward through Richmond to Antioch.

Most of the region is zoned for either residential, commercial/industrial, or open space. Only Sonoma County still has a large part of its territory unclassified or unzoned.

TABLE 9

STATE, COUNTY, AND REGIONAL PARKS AND MILITARY INSTALLATIONS SHOWN IN FIGURE 7, LAND USE AND SPECIAL FEATURES

STATE PARKS

| | | |
|---|---|---|
| Ps | 1 | Bothe-Napa Valley State Park |
| | 2 | Sugar Loaf Ridge State Park |
| | 3 | Jack London State Historic Park |
| | 4 | Tomales Bay State Park |
| | 5 | Samuel P. Taylor State Park |
| | 6 | Stinson Beach State Beach |
| | 7 | Mt. Tamalpais State Park |
| | 8 | Thornton State Beach |
| | 9 | San Gregorio) Pomponio ) State Beaches Pescadero ) |
| | 10 | Butano State Park |
| | 11 | Mt. Diablo State Park |
| | 12 | Henry W. Coe State Park |
| | 13 | Frank's Tract State Recreation Area |
| | 14 | Benicia State Recreation Area |
| | 15 | Portola State Park |
| | 16 | Angel Island State Park |

REGIONAL PARKS (Contra Costa and Alameda Counties)
(L.B.) indicates that there are no facilities.

| | | |
|---|---|---|
| Pr | 1 | J.F. Kennedy Grove Regional Park |
| | 2 | Tilden and Wildcat Canyon Regional Parks |
| | 3 | Point Pinole Regional Shoreline |
| | 4 | George Miller, Jr., Regional Park |
| | 5 | Brooks Island and Point Isabel Regional Park |
| | 6 | Briones Regional Park |
| | 7 | Martinez Waterfront Regional Park |
| | 8 | Shadow Cliffs Regional Recreation Area |
| | 9 | Black Diamond Mines Regional Preserve |
| | 10 | Contra Loma Regional Park |
| | 11 | Morgan Territory Regional Park (L.B.) |
| | 12 | Diablo Foothills Regional Park (L.B.) |
| | 13 | Las Trampas Regional Wilderness |
| | 14 | Chabot and Redwood Regional Parks |
| | 15 | Cull Canyon Regional Park |
| | 16 | Don Castro Regional Park |
| | 17 | San Leandro Bay |
| | 18 | Garin Regional Park |
| | 19 | Coyote Hills Regional Park |
| | 20 | Del Valle Regional Park |
| | 21 | Ridgelands Regional Park (L.B.) |

TABLE 9.
(Continued)

| | | |
|---|---|---|
| REGIONAL PARKS (Continued) | | |
| | 22 | Sunol Regional Park Wilderness |
| | 23 | Mission Peak Regional Park (L.B.) |
| | 24 | Alameda Creek Quarries (L.B.) |
| | 25 | Camp Ohlone |
| COUNTY PARKS | | |
| Sonoma Pc | 1 | Mt. Hood County Park |
| | 2 | Lake Hennessey Recreation Area |
| Napa | 3 | Rector Reservoir Recreation Area |
| | 4 | Milliken Reservoir Recreation Area |
| | 5 | Lake Curry Recreation Area |
| Solano | 6 | Blue Rock Springs County Park |
| Marin | 7 | Deer Park County Park |
| San Mateo | 8 | Coyote Point County Park |
| | 9 | Woodart County Park |
| | 10 | McDonald County Park |
| | 11 | San Mateo County Memorial Park |
| | 12 | Pescadero Creek County Park |
| Santa Clara | 13 | Foothill Park |
| | 14 | Upper Stevens Creek County Park |
| | 15 | Stevens Creek County Park |
| | 16 | Sanborn Canyon County Park |
| | 17 | Sunnyvale Mountain Park |
| | 18 | Villa Montalvo Arboretum |
| | 19 | Santa Teresa County Park |
| | 20 | Uvas Canyon County Park |
| | 21 | Coyote River Park South |
| | 22 | Anderson Lake County Park |
| | 23 | Alum Rock Park |
| | 24 | Ed Levin County Park |
| | 25 | Coyote River County Parkway |
| | 26 | Mt. Madonna County Park |

TABLE 9
(Continued)

MILITARY RESERVATIONS

| | |
|---|---|
| M1 | U.S. Naval Reservation near Binghamton in Solano County |
| M2 | U.S. Military Reservation 4 miles north of Travis A.F. Base |
| M3 | Travis Air Force Base |
| M4 | Concord Naval Weapons Station |
| M5 | U.S. Military Reservation at Rio Vista |
| M6 | Mare Island Naval Shipyard |
| M7 | U.S. Naval Resevvation 8 miles northwest of Mare Island |
| M8 | Hamilton Field A.F. Base (has been declared surplus) |
| M9 | Naval Fueling Station, near Pt. San Pablo, Richmond |
| M10 | Pt. Reyes Coast Guard Station |
| M11 | U.S. Army Transport Facility, Oakland |
| M12 | U.S. Naval Supply Center, Oakland |
| M13 | U.S. Naval Reservation, Treasure Island |
| M14 | U.S. Coast Guard Reservation, Yerba Buena Island |
| M15 | U.S. Naval Air Station, Alameda |
| M16 | Fort Funston, San Francisco |
| M17 | U.S. Military Reservation, Pillar Point |
| M18 | U.S. Naval Air Station, Moffett Field |

## 2. Land Use Trends

In 1975, local jurisdictions throughout the Bay Region set aside some 423,000 acres in developable reserves, an amount equivalent to the land currently urbanized in the region. Estimates are that by 1990 this developable land reserve will be drastically depleted (Reference 16).

Table 10 summarizes land in use and in reserve in the San Francisco Bay Region in 1975. Table 25 presents ABAG's Provisional Series 3 Projections for urbanized and vacant land in 1975 projected to 1990 (Reference 16).

Little information is available on agricultural land uses and trends in the Bay Area. ABAG projects that employment in agriculture will decline, but to a lesser extent with lower population growth. Future agricultural land uses are not projected. To the extent that existing agricultural lands are allowed to be converted to other uses by zoning practices and public services extensions, conversion will take place, assuming that there is sufficient economic incentive to do so. Generally, agricultural lands suitable for industrial, commercial, and residential development are converted because they are worth more as developable land than they can generate in agricultural revenues. In areas where enough developable land is available, agricultural land use can continue unabated. This is the case in Napa and Sonoma Counties.

The projections for urbanized and vacant lands (Table 11) shows little difference, region-wide, between the high and low cases, whereas there is substantial difference in the projected residential and commercial vacant lands.

## E. WATER QUALITY MANAGEMENT

## 1. Water Quality Problems

Currently, the most serious problems occur in the following surface-water resources:

- South San Francisco Bay;
- Napa, Petaluma, and Sonoma River estuaries;
- Near-shore Pacific Ocean Waters (during periods of wet-weather combined sewer bypass of treatment plants);
- Suisun Bay

The nature of the degradation varies. Typical problems include low levels of dissolved oxygen, excessive coliform bacteria, excessive algal growth, and the presence of toxins in bottom sediments.

Forecasting potential future problems is difficult, although important in regional planning schemes. Basically, the future quality of surface water resources will be affected by the level of

TABLE 10
GENERALIZED LAND IN USE AND IN RESERVE
SAN FRANCISCO BAY REGION, 1975

| Land Uses[1] | Land in Use (1,000 acres) | Percent of Total | Land in Reserve (1,000 acres) | Percent of Total |
|---|---|---|---|---|
| Industrial | 67.1 | 15.0 | 77.7 | 18.4 |
| Residential and Commercial | 379.5 | 85.0 | 345.0 | 81.6 |
| Total | 446.6 | 100.0 | 422.7 | 100.0 |

| | | |
|---|---|---|
| Estimated Gross Residential Density[2] | 4.04 du/acre | 1.70 du/acre |

[1]Each category includes estimate for streets and other urban public land.

[2]Dwelling units/acre of residential commercial and urban public land including streets.

TABLE 11
PROJECTED URBANIZED AND VACANT LANDS
BY COUNTY, 1975 AND 1990
(1,000 ACRES)[1]

| Counties | Total Area | Deferred Or Excluded Lands[2] | 1975 | | |
|---|---|---|---|---|---|
| | | | Urbanized[3] | Vacant | |
| | | | | Industrial | Resid. & Commerc. |
| Alameda | 478.8 | 352.2 | 90.4 | 14.0 | 22.2 |
| Contra Costa | 472.3 | 329.0 | 68.1 | 9.7 | 65.5 |
| Marin | 333.5 | 271.7 | 28.1 | 2.5 | 31.2 |
| Napa | 490.2 | 465.5 | 12.6 | 4.8 | 7.2 |
| San Francisco | 30.3 | 5.3 | 24.0 | 0.8 | 0.2 |
| San Mateo | 286.4 | 192.1 | 59.8 | 4.0 | 30.5 |
| Santa Clara | 837.0 | 602.0 | 108.3 | 15.4 | 111.4 |
| Solano | 539.8 | 462.9 | 20.8 | 22.9 | 33.2 |
| Sonoma | 1,015.7 | 933.8 | 34.5 | 3.6 | 43.7 |
| Region | 4,484.2 | 3,614.5 | 446.6 | 77.7 | 345.0 |

[1] Figures may not add to totals due to rounding.

[2] Deferred or excluded lands include open public lands and acreage with no or very low development potential.

[3] Urbanized land includes residential, local-serving, basic, and street/highway acreages.

TABLE 11
(Continued)[1]

| Counties | 1990: Base Case 1[4] | | | 1990: Base Case 2[5] | | |
|---|---|---|---|---|---|---|
| | | Vacant | | | Vacant | |
| | Urbanized[3] | Industrial | Resid. & Commerc. | Urbanized | Industrial | Resid. & Commerc. |
| Alameda | 113.9 | 12.9 | 0.0 | 112.9 | 14.0 | 0.0 |
| Contra Costa | 133.4 | 9.0 | 0.0 | 111.5 | 9.7 | 21.2 |
| Marin | 59.3 | 2.5 | 0.0 | 49.4 | 2.6 | 9.8 |
| Napa | 20.0 | 4.4 | 0.2 | 15.0 | 4.4 | 5.2 |
| San Francisco | 24.3 | 0.7 | 0.0 | 24.2 | 0.8 | 0.0 |
| San Mateo | 90.6 | 3.3 | 0.0 | 90.3 | 3.6 | 0.0 |
| Santa Clara | 223.7 | 11.3 | 0.0 | 203.0 | 12.7 | 19.3 |
| Solano | 54.9 | 22.0 | 0.0 | 36.3 | 22.1 | 18.5 |
| Sonoma | 75.4 | 2.9 | 3.5 | 53.8 | 3.2 | 24.9 |
| Region | 795.5 | 69.0 | 3.7 | 696.4 | 73.1 | 98.9 |

[1]Figures may not add to totals due to rounding.

[2]Deferred or excluded lands include open public lands and acreage with no or very low development potential.

[3]Urbanized land includes residential, local-serving, basic, and streets/highway acreages.

[4]Base Case 1 = High projections, see page .

[5]Base Case 2 = Low projections, see page .

continued pollutant input and any changes in the hydrologic characteristics of a particular water resource.

Pollutant input results from "point" (discrete discharges of municipal or industrial wastewater) and "nonpoint" (diffuse sources including urban and wildland runoff, agricultural wastewater, etc.) sources. The balance between increasingly stringent waste treatment standards and the expanding volume of waste products will most directly affect future water quality. As secondary sewage-treatment facilities (required by the Federal Water Pollution Control Act Amendments of 1972) are installed, the biological quality of receiving waters should improve. On the other hand, the continuing input of nitrogen, phosphorus, and heavy metals to surface waters will probably result in an increase of algal growth and toxins in bottom sediments of the Bay.

Implementation of the current San Francisco Wastewater Management Plan should effectively eliminate the current problem of direct discharge of untreated sewage to the near-shore areas of the Pacific Ocean during rainstorms.

Current water quality problems associated with ground water in the study area's ground-water basins are due primarily to overdraft and saline water intrusion. Both problems are being corrected through recharge of the basins and building of saline water intrusion barriers along the South Bay in Santa Clara Valley, the area of major concern.

Two ground-water systems, the Niles cone in southwestern Alameda County and the upstream ground-water basins of the Livermore-Amador Valley, both in the Alameda Creek watershed, have potential water quality problems caused by the waste load imposed during the dry months of the year by municipal sewage treatment operations. The deeper aquifers are left relatively undisturbed; the upper aquifers in the Livermore-Amador-San Ramon Valleys have high mineral and nitrate content near waste disposal sites.

2. Water Quality Management in the San Francisco Bay Region

The State Water Resources Control Board (SWRCB) is responsible for controlling water quality management throughout California. In particular, the SWRCB determines beneficial uses and establishes water quality standards and criteria to be met. Regional boards are responsible for the implementation of these regulations and criteria. The San Francisco Regional Water Quality Control Board (RWQCB) prepared a water quality management plan for the Bay Area, which was adopted in 1975 (Reference 1).

Of particular importance to sludge disposal is the role of the RWQCB in regulating landfill disposal sites from a water quality standpoint. The SWRCB has published guidelines establishing criteria on landfill site design and a site rating system that determines the type of wastes that a landfill may receive (Reference 2).

The regulatory authority of the SWRCB and RWQCB would also apply to any existing or proposed programs utilizing wastewater solids on agricultural lands, insofar as such a program might affect surface- or ground-water quality.

## F. AIR QUALITY MANAGEMENT

### 1. Wind Data

Wind patterns in the South Bay are heavily influenced by the terrain, resulting in a prevailing flow roughly parallel to the Santa Clara Valley's northwest-southeast axis. Wind speeds are highest in spring and summer and lowest in fall and winter. Night and early morning hours have light winds and are frequently calm in all seasons; summer afternoons and evenings are quite breezy. strong winds are rare, accompanying an occasional winter storm.

The Marin-Sonoma area is fairly sheltered from sea breezes by the Coast Range. Winds blow on a predominantly northwest-southeast axis in the southern part of the region. The northern portion is less sheltered from the sea breeze and frequently exhibits westerly winds. At night, downslope valley flows dominate. Calm and light winds occur more than 55 percent of the time at Santa Rosa. Because of frequent light winds, the pollution potential of the Marin-Sonoma area is moderately high to high. Despite a high potential for pollution, pollutant levels are low compared to most of the Bay Area, due to the lack of industry and the low level of development (Reference 7).

The inland Livermore-Amador Valley has a high frequency of calm. Predominant wind directions reflect the location of the Hayward Gap to the west and the Niles Canyon to the southwest.

Most of the Contra Costa areas are exposed to strong flow through the Golden Gate and Carquinez Strait. The northern Diablo Valley, however, is somewhat sheltered and has lighter winds oriented in a north-south direction.

Winds in the Napa-Solano area reflect the gross terrain. Winds at Napa are southerly. The range of hills separating Napa and Solano Counties causes winds near Fairfield to be primarily southwesterly, reflecting the position of Carquinez Strait. Wind speeds are generally higher in Fairfield than in Napa.

Wind conditions vary across the East Bay. At the north, near Oakland, winds are strong and from the west, reflecting the area's exposure to winds from the Golden Gate. Further south, winds decelerate and become northwesterly. The Fremont-Newark area has frequent light winds.

The wind regime in the San Mateo subregion strongly reflects the proximity of mountain gaps such as the San Bruno and Crystal

Springs gaps. The frequency of winds from west through northwesterly directions exceeds the frequency from all other directions combined. A slight secondary maximum from the southeast reflects the influence of winter storms. Wind speeds are relatively high compared to other areas of the Bay, especially in the westerly directions.

## 2. Present Emissions

Air quality standards set limits on the amount of various types of air pollution that should be tolerated in the air people breathe. State and Federal air quality standards are shown in Table 12. Wherever thare is some variation between State and Federal air quality standards, the stricter one applies.

Major current pollutant problems are oxidant, carbon monoxide, and particulates. Table 13 and Figures 3a-c summarize exceedances of the standards for these pollutants throughout the Bay Area.

In 1975, the oxidant standard was exceeded at all monitoring sites except the two in San Francisco. Monitoring sites directly affected by wind through the Golden Gate generally exceeded the standards a few days. South of San Francisco, the number of exceedances increased rapidly to a maximum of 49 days at the Alum Rock station in San Jose (see Figure 3a). Exceedances also increased east from San Francisco, reaching a secondary maximum at Livermore, which is affected by both pollutants carried over the East Bay hills and emissions generated locally.

The State suspended particulate standard for 24 hours was exceeded at 15 of the 18 sites where it was monitored in 1975 (it should be noted that particulates are measured only every sixth day). The pattern of particulate exceedances is similar to that of oxidant exceedance, with frequency increasing south and east from San Francisco.

The annual geometric means of total suspended particulate (TSP) show a pattern of low values near the coast, increasing with distance inland, particularly into dry, sheltered valleys. The values shown on Figure 3c are given in micrograms per cubic meter ($\mu g/m^3$), which is a measure of weight. The Federal primary standard, expressed as an annual geometric mean, is 75 $\mu g/m^3$ and the State standard is 60 $\mu g/m^3$. In 1975 the Santa Clara and Livermore Valley areas exceeded the State standard, and the Livermore Valley exceeded the Federal standard as well.

Sulfur oxides are a problem in the Bay Area near the large oil refineries and chemical plants concentrated in Contra Costa County. Therefore, the monitoring network of 11 sites ranges from Santa Rosa and Richmond on the west to Pittsburg and Napa on the east. The standards were exceeded in 1975 only at Crockett and Point Richmond, both of which are close to major sources.

TABLE 12
FEDERAL AND STATE AIR QUALITY STANDARDS

| Substance | Federal Standards Primary | Federal Standards Secondary | State Standard | Objective |
|---|---|---|---|---|
| Sulfur Dioxide | | | | To prevent increase in respiratory disease, plant damage & odor |
| Annual Average | 0.03 ppm | 0.02 ppm | | |
| 24-Hour Average | 0.14 ppm | 0.10 ppm | 0.04 ppm | |
| 3-Hour Average | 0.50 ppm | 0.50 ppm | -- | |
| 1-Hour Average | -- | -- | 0.50 ppm | |
| Carbon Monoxide | | | | To prevent carboxyhemoglobin levels greater than 2% |
| 8-Hour Average | 9 ppm | Same | -- | |
| 1-Hour Average | 35 ppm | Same | 40 ppm | |
| 12-Hour Average | -- | -- | 10 ppm | |
| Oxidant | | | | |
| 1-Hour Average | 0.08 ppm | Same | 0.10 ppm | To prevent eye irritation, breathing difficulties |
| Particulate | | | | To improve visibility |
| Annual Average | $75 \mu g/m^3$ | $60 \mu g/m^3$ | $60 \mu g/m^3$ | |
| 24-Hour Average | $260 \mu g/m^3$ | $150 \mu g/m^3$ | $100 \mu g/m^3$ | |
| Nitrogen Dioxide | | | | To prevent health risk and improve visibility |
| Annual Average | 0.05 ppm | Same | -- | |
| 1-Hour Average | -- | -- | 0.25 ppm | |
| Non-Methane Hydrocarbon 6-9 a.m. Average | 0.25 ppm | Same | -- | To prevent oxidant buildup |
| Lead 30-Day Average | -- | -- | $1.5 \mu g/m^3$ | To prevent health problems |
| Hydrogen Sulfide 1-Hour Average | -- | -- | 0.03 ppm | To prevent odor |
| Visibility | -- | -- | 10 mi. + when rel. humidity 70% | To improve visibility |

Source: Reference 23.

TABLE 13
OCCURRENCES OF SELECTED POLLUTANTS
EXCEEDING FEDERAL OR STATE STANDARDS, 1975[1]

| Station | Oxidant (1-hr.) | Carbon Monoxide (8-hr.) | Nitrogen Dioxide (1-hr.) | Particulates[2] (24-hr.) |
|---|---|---|---|---|
| South Bay | | | | |
| Gilroy | 20 | 0 | 0 | 4 |
| San Jose | 48 | 23 | 0 | 9 |
| Los Gatos | 34 | -- | -- | -- |
| Alum Rock | 49 | -- | -- | -- |
| Sunnyvale | 14 | 9 | 0 | 0 |
| Mountain View | 17 | -- | -- | -- |
| San Francisco | | | | |
| Ellis Street | 0 | 5 | 0 | 2 |
| 23rd Street[3] | 0 | 0 | 1 | 7 |
| Marin-Sonoma | | | | |
| San Rafael | 1 | 2 | 0 | 0 |
| Petaluma | 1 | -- | -- | -- |
| Santa Rosa | 3 | 0 | 0 | 1 |
| Livermore-Amador Valleys | 28 | 0 | 0 | 24 |
| Contra Costa | | | | |
| Richmond | 2 | 0 | 0 | 4 |
| Pittsburg | 2 | 0 | 0 | 5 |
| Concord | 5 | 0 | 0 | 2 |
| Napa-Solano | | | | |
| Napa | 25 | 0 | 0 | 1 |
| Fairfield | 15 | -- | -- | -- |
| Vallejo | 11 | 19 | 0 | 3 |
| East Bay | | | | |
| Oakland | 2 | 4 | | 11[4] |
| San Leandro | 14 | -- | -- | -- |
| Hayward | 29 | -- | -- | -- |
| Fremont | 22 | 0 | 1 | 9 |
| San Mateo | | | | |
| Burlingame | -- | 0 | 9 | 0 |
| Redwood City | 13 | 2 | 0 | 1 |

[1]Source: Reference 24.
[2]24-hour samples of particulates taken every sixth day.
[3]Measurements made between May and December only.
[4]Samples taken every two days.

The 8-hour average carbon monoxide standard was exceeded at seven of the 16 monitoring sites where it was measured. Rather than exhibiting a regional pattern, these exceedances are related to the density of traffic surrounding monitoring sites (see Figure 3b). The standard was most frequently exceeded at San Jose, where violations occurred on 23 days. It was exceeded a few times at locations along the San Francisco peninsula, and at the population centers of Oakland and San Francisco.

### 3. Air Quality Problems

The San Francisco Bay Area Basin has been designated as an Air Quality Maintenance Area by the California Air Resources Board. This requires the development of a long-term air quality strategy to attain and maintain the National Ambient Air Quality Stnadards between 1977 and 1985. The development of this Air Quality Maintenance Plan began in 1976 and will take two years.

The Bay Area contains a multitude of air pollutant sources. Automobile exhaust is the greatest single source. Nonvehicular sources such as refineries, manufacturing plants, and generating plants are concentrated in the industrial areas of San Francisco, Oakland, Emeryville, and Northern Contra Costa County.

The pollution potential of the South Bay is high during the entire year. By virtue of its location downwind of the major urban centers, this area is a receptor for Bay Area pollutants. The background level is therefore already high, aside from any local contribution. Dilution of pollutants emitted in the Santa Clara Valley is restricted laterally by terrain boundaries and vertically by frequent inversions. Generally, light winds and frequent recirculation of pollutants by evening drainage flows increase the pollution potential.

There are few major sources of problem odors in the South Bay. Complaints were often received near the now-abandoned Milpitas Sewage Treatment Plant (Reference 25).

San Francisco's air quality is among the best in the region. The city is almost constantly subjected to a steady flow of air from the west that carries pollutants to other parts of the Bay Area. Also, San Francisco is generally upwind of major sources and urban areas. Despite these advantages, there are periods, most often in fall and winter, when the air becomes stagnant.

Odor complaints in San Francisco are associated mainly with specific manufacturing processes. Some complaints of sewer odors are received, normally in the old sections of the sewage system, where subsidence has caused sewage to pool (Reference 26).

There are few major odor problems in the Marin-Sonoma area due to the lack of industry. Complaints have been received in the past from the vicinity of the San Rafael sewage treatment plant (Reference 27).

The pollution potential of the Livermore-Amador Valley is very high. The surrounding elevated terrain, in conjunction with temperature inversions, frequently makes a closed box of the valleys in which pollutants may quickly reach high levels during periods of low wind speed. Abundant sunshine and warm temperatures in summer are ideal conditions for the formation of photochemical oxidant, and the valleys are a frequent scene of photochemical pollution even in the absence of local sources, due to sea-breeze transport of contaminants from westward urban areas (Reference 7).

In the Contra Costa subregion, air pollution potential is low along the Carquinez Strait and San Pablo Bay but high in the inland valleys. Exposure to winds results in relatively low concentrations of pollutants (Reference 7). Odor complaints have been generated in the past by the Central Contra Costa Sanitary District sewage treatment facility in Concord. The now-abandoned sludge digesters and lagoons appear to have been the major problems (Reference 28).

The air pollution potential at Napa is high; in Solano County it is very low, due to its exposure to wind (Reference 7).

The pollution potential of the East Bay varies from low in the north to high in the south. Air quality also varies greatly across the subregion. Air moving southeast picks up more and more pollutants as it travels, so that air quality deteriorates with southward movement.

The pollution potential for San Mateo is generally lower than at most Bay Area sites, since the moderate wind speeds result in considerable horizontal dilution of pollutants. The marine inversion is persistent in the area, however, and high pollutant levels can be realized whenever winds die down, especially in the southern part of the region (Reference 7). Odor complaints have been received about the sewage treatment plants located in Redwood City and Pacifica (Reference 29).

4. Expected Air Quality Trends

Federal, State, and local air pollution policies and control strategies have resulted in considerable improvement in air quality in the Bay Area since regulation of pollution emissions began in 1955. Air quality control programs are administered by the State Air Resources Board (ARB), the Bay Area Air Pollution Control District (BAAPCD), and the U.S. Environmental Protection Agency.

The ARB is responsible for enforcing controls on vehicles. The jurisdiction of the BAAPCD is largely limited to nonvehicular sources, primarily industry and burning. The BAAPCD is also responsible for the investigation of odor complaints.

The U.S. Environmental Protection Agency has promulgated New Source Performance Standards for sewage treatment plants, adopted by the Bay Area Air Pollution Control District in Regulation 7, Rule 13.

The rule sets forth maximum particulate emissions (based on sludge input) and limits the opacity of emissions.

The Air Quality Maintenance Plan is a long range strategy for the attainment and maintenance of the air quality standards. The development of the Plan is being overseen by the Association of Bay Area Governments in cooperation with the BAAPCD and the Metropolitan Transportation Commission.

Predictions of future air quality are not currently available, but predictions of future emission loadings are available (Reference 30). This emission inventory is currently being updated and will be used as input for forecasts of future air quality to be made as part of the Air Quality Maintenance Program.

Of particular importance to the development of sewage sludge disposal alternatives are future trends in particulate emissions. Particulate emissions are expected to increase steadily through 2000, although they will remain will below emissions prior to initiation of controls. This increase is linked to increases in sulfur dioxide emissions, which result in the formation of sulfate particulates. Sulfur dioxide emission increases are a result of anticipated use of sulfur-containing fuel oil to replace natural gas, which will be in short supply in the future.

Particulate concentrations will continue to exceed the ambient air quality standards in the future under current assumptions of fuel supply and demand and population growth. New particulate control strategies may be implemented, however, that would alter the present trend.

## G. SOLID WASTE MANAGEMENT

### 1. State Mandate

Recognizing a need to address solid waste management concerns, the State legislature passed the California Solid Waste Management and Resource Recovery Act of 1972. This legislation established the State Solid Waste Management Board (SWMB) and gave the responsibility for preparing individual solid waste management plans to California's counties. Each plan must be approved by a majority of cities in that county, representing a majority of the population in the incorporated areas. The plans must then be approved by the SWMB. Thereafter, solid waste management activities at the local level must be consistent with the approved plans. By May 1977, five of the nine county plans for the Bay Area (San Francisco, Napa, San Mateo, Contra Costa, Santa Clara) were fully or conditionally approved by the SWMB (Reference ABAG, May 31, 1977).

## 2. Relation of County Plans to ABAG EMP Solid Waste Management Program

ABAG's Environmental Management Plan (EMP) is being prepared under the Water Pollution Control Act Amendments of 1972, which require the preparation of area-wide water quality management plans in urban/industrial areas. The Plan is being prepared by ABAG in cooperation with local, regional, State, and Federal agencies. It will include seven management components: surface runoff, air quality maintenance, municipal wastewater facilities, non-point sources of water pollution, industrial discharges, water conservation reuse and supply, and solid waste (including municipal wastes, hazardous wastes, and wastewater residuals).

The approach for EMP solid waste management planning is to build on work in progress or completed by other agencies. The work program emphasizes two planning objectives: the first is to develop a plan for the period to 1980 consisting primarily of programs for early implementation that begin to address impairment of air and water quality, public health and safety effects, aesthetic and nuisance effects, ecological effects, and resource depletion effects of land, energy and reusable materials, and waste. The second planning objective is to develop a continuing planning process.

The county solid waste management plans will serve as a basis for ABAG's planning to achieve these objectives. The plans contain descriptions of the current solid waste management practices and facilities for each county in the Bay Area. For the short, medium, and long term, options for future systems are considered and recommended. The planning documents themselves are extensive and contain considerable information on solid waste practices in general and on conditions unique to each county.

## 3. Regional Overview of County Solid Waste Management Plans

a. Existing Systems. Many cities and counties have local ordinances regulating the storage of solid waste; however, the ordinances in general do not include all the minimum standards as adopted by the SWMB in December, 1974. Most residential wastes are collected by private franchised collectors. Franchises are issued by cities and counties and sometimes by special districts. Only three cities in the Bay Area operate their own collection services (Berkeley, San Leandro, and Dixon). In many cases, collection of residential waste is required by local ordinance.

Wastes are usually taken by the collection trucks directly to landfill sites for disposal. In some cases, because of the long distance between collection points and disposal sites, transfer facilities are needed in order to reduce transportation costs. At a transfer station, collected wastes are transferred to much larger long-haul trucks for transportation to a disposal site. In 1975 there were about five such transfre stations in the Bay Area. The largest is located in San Francisco. It is also the only transfer

station that included mechanical waste processing such as shredding and recovery of metal cans in 1975.

There were about 60 active landfill sites in the Bay Area in 1975, including three Class I sites for hazardous waste disposal. Many of these sites will be closed by 1980.

In general, cities, counties, and special districts are responsible for solid waste management. The cities and counties have authority for collection, processing, and disposal of wastes within their jurisdictions. Collection of wastes by the franchised collectors are regulated by the city councils or the county boards of supervisors.

Many city and county agencies are involved with various aspects of solid waste management. Typically, the city and county health departments inspect waste disposal activities and enforce waste handling standards. The County Planning Department of Public Works Department is responsible for county-wide solid waste management planning and reviews permit applications for new solid waste facilities.

In addition, depending on location and type of facility, permits for new or expanded solid waste facilities may be required from the San Francisco Regional Air Quality Control Board, Bay Area Air Pollution Control District, San Francisco Bay Conservation and Development Commission, California Coastal Zone Conservation Commission, State Lands Commission, and U.S. Army Corps of Engineers.

Collection services provided by private companies are paid through user fees. Landfill revenues come from disposal fees charged to commercial haulers and private citizens. In general, collection accounts for 80 to 90 percent of system costs because it is so labor intensive. Disposal operations account for 10 to 20 percent of total costs.

The many public agencies involved in solid waste management incur costs related to administration, planning, regulation, enforcement, and operation of activities. These costs are spread among the involved agencies and are partially financed through public funds and franchise fees.

b. Future Systems--1980. Attempts will be made by the cities and counties to make storage and collection standards more uniform. State standards will be the minimum for any adopted county standards. These will include collection service available in all service areas, minimums for frequency of collection, locations, and specifications for containers.

c. Regional Issues in County Plans. An important aspect of the county Plans for EMP solid waste planning is the identification of regional solid waste issues. The regional planning issues as identified by the local plans are: development of dependable

markets for recovered materials; evaluation of large-scale resource recovery systems; assurance of hazardous waste disposal capacity; and wastewater solids management planning for the increased volume resulting from required air emissions in wastewater treatment facilities. These issues have implications beyond any one county; solutions to these regional problems may require an area-wide approach. The large-scale resource recovery facilities necessary for economic feasibility may require wastes from several jurisdictions. Solutions may involve special or expensive facilities that would be costly for any one county to finance. They may require coordination of physical systems or administrative responsibilities involving two or more agencies.

4. Bay Area Solid Waste Management Project

The Bay Area Solid Waste Management Project (BAYSWAMP) involves the development of a comprehensive solid waste management program for the San Francisco Bay Area. The intent of the study is to evaluate all reasonable approaches and to recommend actions or projects that will provide local, State, and Federal officials with knowledge and recommendations for decision making to establish a solid waste management program. The objectives of the study are to establish sets of priorities for managing the Bay Area's solid wastes. Phase I of the study has been completed. The report concludes that solid wastes must be managed according to the State's minimum standards and that standards must be properly enforced. Alternatives will be evaluated in detail over the next two years.

## H. TRANSPORTATION SYSTEMS

Regional truck lines carry most travel through defined transportation corridors within the region. They include most of the completed freeways, all of the transbay and strait bridges, the major rail transit lines, and the ferry system.

The highway trunk lines include the major interregional connecting links: U.S. 101 to the north through Sonoma County and to the south through Santa Clara County, Interstate Routes 505 and 80 through Solano County to the north and east, Interstate 580 east and south through Alameda County, Route 17 south from San Jose, and the route around the urban area formed by Interstate 680 and Route 21 between San Jose and Cordelia. In the urban area, the trunk lines include Routes 101 and 280 between San Jose and San Francisco, Route 17 from San Jose through Oakland to Richmond, Interstate 580 between Castro Valley and the Bay Bridge, and a number of other heavily-traveled interconnecting links such as Routes 24, 92, and 85 (see Figure 8).

The regional system includes an extensive support system of roads, streets, and distributive mass transit facilities that connect the local transportation systems in each corridor to the regional trunk

lines. Roads include the other routes in the state highway system, ranging from important rural highways such as Routes 1, 12, 37, and 29 in the North Bay to major city streets such as El Camino Real on the Peninsula, 19th Avenue/Park Presidio Boulevard in San Francisco, and San Pablo Avenue, East 14th Street, and Mission Boulevard in the East Bay. Major county highways and city arterials throughout the region are also important to the support system.

A number of terminals in the region function as major transfer points within the regional transportation system in the movement of either people or goods. Six major port facilities are located in the San Francisco Bay Region: Encinal Terminals (Alameda) and the Ports of Benicia, Oakland, Redwood City, Richmond, and San Francisco. Most waterborne cargo is handled by private concerns.

# SECTION III
# IMPACT ASSESSMENT CRITERIA

## A. GENERAL DISCUSSION

The Association of Bay Area Governments is developing an Environmental Management Plan for the San Francisco Bay Area. This program is funded by the U.S. Environmental Protection Agency under Section 208 of the Water Pollution Control Act Amendments of 1972. In addition to problems of water quality, the plan will address problems of air quality and solid waste.

The solid waste management plan will include plans for municipal waste, hazardous waste, and wastewater residuals. This latter plan is the subject of the Wastewater Solids Study.

Development of the impact assessment criteria for this study was coordinated closely with the Association of Bay Area Governments to insure compatibility with their Assessment/Evaluation Program.

The goal of the assessment process is to develop and present information on the full range of effects that might be associated with alternative management plans, in this case plans for wastewater solids management. The impact assessment criteria for the Wastewater Solids Study are presented herein in two forms: an assessment checklist and an assessment matrix.

The checklist is organized into four broad categories: environmental, institutional and financial, economic, and social. It shows special types of impacts that might be associated with options for processing, transportation, or disposal. Not every factor that appears on the checklist will be used to assess every option. The process is designed to insure the identification of the most relevant and meaningful impact information.

The purpose of the matrix is to provide a screening mechanism. The matrix indicates where there is no identifiable link between an option and an assessment factor. It also indicates the nature or level of impact, which focuses impact prediction on appropriate assessment factors. The rankings denote the degree of effort or depth of analysis required to predict the impacts of the control measure. The A, B, C, and - rankings that appear on the matrix are defined as:

A = direct, substantial, immediate, and significant impact; requires quantitative analysis if possible;
B = direct or indirect impact that might be significant; requires quantitative analysis if possible to determine whether impact is significant;
C = marginal indirect impact; qualitative discussion is required; and
\- = no significant relationship; no discussion required.

Table 14 shows the matrix developed for the Wastewater Solids Study.

## B. ENVIRONMENTAL CONSIDERATIONS

### 1. Air Quality and Odor

a. Significance of Effects. All effects are likely to have some significance for the air quality and odor assessment category, except prestabilization.

b. Assessment Criteria Checklist

1) Federal standards for air quality (primary and secondary)

| | |
|---|---|
| Total suspended particulates | Hydrocarbons |
| Carbon monoxide | Sulfur dioxide |
| Photochemical oxidants | Nitrogen dioxide |

2) State standards for air quality

| | |
|---|---|
| Lead | Ethylene |
| Sulfate | Visibility-reducing particulates |
| Hydrogen sulfide | |

3) Bay Area Air Pollution Control District emission limitations for:

| | |
|---|---|
| Sulfur dioxide | Particulate matter |
| Hydrogen sulfide | Odorous substances |
| Visible emissions | |

4) Other air quality considerations

Fugitive dust emissions
Ozone-reactive emissions
Toxic substance and heavy metal emissions

5) Odor: type, severity, location, and duration

### 2. Water Quality and Quantity

a. Significance of Effects. Prestabilization and dewatering are two of several processes that are completely contained within a treatment plant. Although they may affect the quality of wastewater effluent, their impact is not considered significant with respect to water quality. Any impact they may have would be more appropriately examined under "Disposal Use."

TABLE 14
NON-SITE-SPECIFIC ASSESSMENT MATRIX

| Assessment Categories | Prestabilization | Stabilization | Dewatering | Drying | Combustion | Transport | Storage | Disposal Use |
|---|---|---|---|---|---|---|---|---|
| Environmental | | | | | | | | |
| Air Quality, Odor | -- | A | C | A | A | A | C | B |
| Water Quality & Quantity | -- | A | -- | A | A | C | B | A |
| Land Resources | -- | -- | -- | -- | -- | C | A | A |
| Flora & Fauna | -- | -- | -- | A | -- | C | A | A |
| Material (Physical) Resources | A | A | A | A | A | A | A | A |
| Energy | B | B | B | A | A | A | B | B |
| Amenities, Visual & Cultural | C | C | C | C | C | C | C | C |
| Noise | B | B | B | B | B | B | -- | B |
| Economic | | | | | | | | |
| Economic Activity | C | C | C | C | C | C | C | C |
| Social | | | | | | | | |
| Housing Supply | -- | -- | -- | -- | -- | -- | C | C |
| Physical Mobility | -- | -- | -- | -- | -- | C | -- | -- |
| Health & Safety | B | B | B | B | B | B | B | A |
| Sense of Community | -- | -- | -- | -- | -- | B | B | B |
| Urban Patterns/Land Use | -- | -- | -- | -- | -- | A | A | A |
| Growth Inducement | -- | -- | -- | -- | -- | -- | -- | C |
| Equity | C | C | C | C | C | C | C | C |

A = Significant impact. B = Potentially significant impact. C = Indirect marginal impact.
- = No impact.

b. Assessment Criteria Checklist

1) The effect of each wastewater solids management process on the following "beneficial uses" as defined by the State Water Resources Control Board (Reference 1) will be examined for all surface-water and ground-water resources that may be affected:

- Municipal & domestic supply
- Agricultural supply
- Industrial process supply
- Industrial service supply
- Ground-water recharge
- Fresh-water replenishment
- Water-contact recreation
- Non-contact water recreation
- Preservation of rare and endangered species
- Wildlife habitat
- Marine habitat
- Fish migration
- Fish spawning
- Shellfish harvesting
- Warm fresh-water habitat
- Cold fresh-water habitat
- Saline water habitat
- Preservation of areas of special biological significance

2) The quantifiable water quality factors that form the basis for determining the impact on beneficial uses are tabulated below (not all of these factors will need to be investigated for each treatment process).

Physical

- Turbidity
- Color
- Taste
- Odor
- Residue
- Oil and grease
- Total suspended solids (TSS)
- Total dissolved solids (TDS)
- Total volatile solids
- Electrical conductivity

Bacteriological

- Fecal coliforms
- Dissolved oxygen (DO)
- Biochemical oxygen demand (BOD)
- Viruses and bacteria:
  - Polio virus 1
  - Echo virus 7
  - Echo virus 12
  - Coxsackie virus A9
  - Aerobacter aerogenes
  - Escherichia coli
  - Streptocccccus faecalis
  - Ascaris

Chemical

- pH (acidity)
- Alkalinity
- Hardness
  - Phenols
- Sulfate, sulfite, sulfide
- Phosphate (total phosphates, orthophosphates, polyphosphates)
- Other anions (chloride, fluoride, iodide, cyanide)
- Nitrogen (nitrate, nitrite, ammonia, organic)
- Chlorine
- Pesticides

Heavy metals:

| | | | |
|---|---|---|---|
| Aluminum | Chromium | Magnesium | Selenium |
| Arsenic | Cobalt | Manganese | Silver |
| Barium | Copper | Mercury | Sodium |
| Boron | Iron | Molybdenum | Strontium |
| Cadmium | Lead | Nickel | Vanadium |
| Calcium | Lithium | Potassium | Zinc |

3. Land Resources

a. Significance of Effects. Prestabilization, stabilization, and dewatering are three of several processes that are completely contained within a treatment plant. Although the use of a particular method in any of the above processes will ultimately affect the quality of the solids produced and thus indirectly also affect the land quality, this type of impact is best considered under "Disposal Use". Combustion and drying are also essentially self-contained processes, and the only land resources affected will come under the "Disposal Use" Option.

b. Assessment Criteria Checklist

1) Topography

Erosion
Landslides
Natural drainage
Runoff
Slope map
Vegetative cover
Depth to ground water

2) Geological

Faulting/seismic
Subsidence hazards
Nature of bedrock
Depth of bedrock

3) Soil physical properties

Type
Permeability
Structure/swelling properties
Texture
Infiltration properties

4) Soil chemical properties

Heavy metals
pH
Cation-exchange capacity
Plant nutrients

5) Land-related uses

Prime or unique agricultural land
Other agricultural land
Tidelands, marshes, coastal zones, estuaries
Wildlife habitat
Hilly land, fragile land, or land subject to erosion

6) Lands with special development characterictics

| | |
|---|---|
| Seaports | Energy sites, including natural gas fields (PG&E 10-year forecasts) |
| Airports | |
| Marinas, harbors | |

7) Recreation use and potential use

| | |
|---|---|
| Parks | Zoos |
| Beaches | Etc. |
| Stadia | |

8) Solid waste

| | |
|---|---|
| Disposal sites | Resource recovery potential |
| Solid waste volume | Hazardous materials |

4. Flora and Fauna

a. Significance of Effects. Prestabilization, stabilization, dewatering, and combustion are generally conducted within buildings at a wastewater treatment plant. Thus, the only impact of these processes on biological habitat is the space taken up by the existing or new structure.

Some habitat may be lost during plant expansion; this would seldom involve more than one to two acres. If the wastewater solids are dewatered outside on sand filters or lagoons, it is possible that larger acreages may be involved, depending on the size of the treatment plant. In these cases, the acreage loss must be considered an impact although, unless the area disturbed is biologically valuable, the impact would be slight. Proper landscaping with native plants can compensate for much of the habitat loss.

b. Assessment Criteria Checklist

1) Aquatic habitat

2) Preserved areas of significance

3) Preserved endangered species

4) Fish migration

5) Fish spawning

6) Shellfish harvesting

7) Food and Cover

8) Noxious flora and fauna

5. Material Resources

a. Significance of Effects. All effects are likely to be significant for the material resources assessment category.

b. Assessment Criteria Checklist

Mines, quarries, mineral-bearing lands, e.g., sand and gravel
Timber-producing and other forested lands
Salt ponds
Geothermal sites (known geothermal resource areas)
Mineral resources

6. Energy

a. Significance of Effects. All effects are likely to have some significance for the energy assessment category.

b. Assessment Criteria Checklist

1) Effect on energy demand

Natural gas consumption
Electric consumption
Petroleum consumption
Coal and other non-renewable energy resources consumption

2) Effect on energy supply

Natural gas supply
 Availability
 Peak and non-peak usage
Electrical supply
 Availability
 Peak and non-peak usage
Petroleum supply
Coal or other non-renewable energy resources consumption

3) Energy conservation

Efficiency of energy use
Resource recovery and recycling
Energy production
Use of alternative energy sources

7. Visual and Cultural Amenities

a. Significance of Effects. Some indirect impacts are likely for the visual and cultural amenities assessment category.

b. Assessment Criteria Checklist

1) Visual amenities

Preservation of scenic amenities, natural state of the environment, and open space
Height and bulk of sludge-related structures; appearance
Aesthetics of clean air
Urban landscape

2) Historic and cultural resources

Historic landmarks
Monuments
Districts
Archaeological sites
Other areas of historic or cultural significance
Sites of special water-related historical significance

8. Noise

a. Significance of Effects. Storage options consist of lagoon storage or stockpiling. Neither process involves use of equipment or vehicles, or natural processes that could generate noise.

b. Assessment Criteria Checklist

1) Stationary noise sources

Strength
Time variation
Frequency
Attenuation

2) Transportation noise sources

Strength
Emission character
Time variation
Frequency
Attenuation

3) Construction noise sources

Strength
Duration
Time variation

C. ECONOMIC ACTIVITY

1. Significance of Effects. At least some marginal impacts are likely for the economic activity assessment category.

## 2. Assessment Criteria Checklist

### a. Production of Goods and Services

1) Number of direct jobs created or eliminated by each processing and disposal option (express in category of PLUM Model or BEMOD)

Construction employment
Operation employment
Other employment created, such as additional agricultural employment

2) Number of jobs created by the "multiplier effect" of jobs in:

Construction
Operation
Other employment

### b. Income and Investment

1) Measure aggregate wages for:

Construction employment
Operation employment
Other employment
Employment generated by the multiplier effect

2) Impact of employment on total wages and salary in the area. Utilize information on 1) and connection tables to be provided by ABAG.

3) Impact on rents (this is not expected to be an impact)

4) Effect on capital investment of new and replacement facilities or equipment

Determine whether control options will require private capital investment
Measure required private capital investment
Measure the effect of such investment on profits of private businesses

### c. Consumer Expenditures

1) Effect of the prices of goods and services due to the cost of improvements being passed on to the consumer. This will be measured by the increase in wastewater treatment rates and charges to the consumer.

2) Effect on the consumption of goods and services. Consumption could be affected indirectly by a change in the price of goods or services. This is expected to be nonexistent or minimal as in c.1), above.

d. Impact on Local Property Tax Base

1) Change in property ownership to public use

2) Resulting change in the assessed values of property

3) Impact of d.1) on the local property tax base

## D. SOCIAL

### 1. Housing Supply

a. Significance of Effects. Only storage and ultimate disposal will affect the housing supply. The actual processing options and transportation are not likely to have an effect.

b. Assessment Criteria Checklist

1) Effects on existing housing stock

Impact on the removal of housing by demolition or conversion
Impact on housing quality

2) Effect on new housing stock, including cost of new housing.

### 2. Physical Mobility

a. Significance of Effects. Only the transport category would have any effect on the public/private transportation networks. The ultimate disposal and processing options should not affect the transportation factors of the respective sites.

b. Assessment Criteria Checklist

Impact on local public and private transportation
Demand (average daily trips)
Convenience
Cost

### 3. Health and Safety

a. Significance of Effects. All effects are likely to have some significance for the health and safety assessment category.

b. <u>Assessment Criteria Checklist</u>

1) Seismic safety

2) Floodplains

3) Pathogens

4) Heavy metals

4. <u>Sense of Community</u>

a. <u>Significance of Effects</u>. The processing options would not affect the character of the community or its stability.

b. <u>Assessment Criteria Checklist</u>

1) Effect on community character

2) Effect on community stability

5. <u>Urban Patterns/Land Use</u>

a. <u>Significance of Effects</u>. The on-site treatment options for wastewater solids (prestabilization, stabilization, dewatering, drying, and combustion) would not affect land use patterns in the study areas since they would be located at existing facilities.

b. <u>Assessment Criteria Checklist</u>

1) Required land (location and density of development)

2) Available land and existing use

3) Extent of displacement of existing uses

4) Disruption of site and adjacent uses

5) Adjacent uses

6) Projections of future use of development site

7) Effect of timing of development

8) Compatibility with local/regional land use plans

6. Growth Inducement[1]

a. Significance of Effects. Growth-inducing impacts would be measured by the way in which a proposed project could foster economic or population growth either directly or indirectly. The project could make growth possible through the provision of a service. Wastewater solids management is only one of the public services that must be provided; however, it is essential.

b. Assessment Criteria Checklist

1) Removal of obstacles to population growth

2) Impact of estimated increase in population growth (if any) on existing community services

3) Project characteristics that might facilitate or encourage other activities that could significantly affect the environment, either singly or cumulatively

7. Equity

a. Significance of Effects. At least indirect marginal impacts are likely.

b. Assessment Criteria Checklist

1) Impact on individual opportunity and life style

2) Impact on special population groups

[1]Although not listed as one of ABAG's assessment criteria, growth is a required element that must be considered.

## SECTION IV
## BAY REGION CHARACTERISTICS

### A. BOUNDARIES AND COMPOSITION

#### 1. Geographical Setting

Situated on the central California coast, the San Francisco Bay Region comprises one of the west coast's major urban/industrial centers (see Figure 1). The unique configuration of the Bay makes it a superb natural harbor. This feature, combined with the pleasant, moderate climate, resulted in the early settlement of the region by the first immigrants, the Spanish, and its rapid development. As will be evident from this report, the climate and geographical setting of the Bay remain the most important factors in the development of the region.

The regional study area includes all or portions of the counties of Marin, Sonoma, Napa, Solano, Contra Costa, Alameda, Santa Clara, San Mateo, and San Francisco. County boundaries are shown in Figure 2. The subregional boundaries, also shown in Figure 2, result from a series of water quality management plans, discussed in Reference 1, and generally reflect existing wastewater treatment districts.

#### 2. Topography

The topography of the San Francisco Bay Basin (Figure 5) is dominated by the California Coast Ranges, a number of parallel ranges averaging about 50 miles in width and trending northwest to southeast. In the west the Coast Ranges rise abruptly from the sea, in many places notched by a series of wave-cut terraces, the highest ones more than 1,500 feet above sea level and one to two miles wide.

The valleys vary in origin and therefore in morphology. The largest, Santa Clara Valley, 100 miles long and up to 15 miles wide, is a down-dropped or down-tilted block draining in the north into San Francisco Bay and in the south into Monterey Bay. San Francisco Bay itself is an irregular down-warped, drowned valley, complicated by faulting and modified by sedimentation. Other valleys either are steep fault incisions or follow broad synclinal forms.

In a large part of the study area, the soil cover is very susceptible to erosion, especially in the mountainous regions and in the foothills of the Coast Ranges. Erosion hazards are less prominent in and around the intermountain valleys.

In the South Bay, the Santa Clara Valley extends northwesterly throughout the subregion, and is flanked on either side by complex ridges with rugged slopes varying from 20 to 60 percent.

The San Mateo subregion is dominated by the Santa Cruz Mountains in the east and the flat-lying artificial Bay fill in the west. The steep hillsides in the Santa Cruz Mountains are very susceptible to landsliding, and many structurally damaging slides have occurred in this region in historic times (Reference 2).

San Francisco's topography has resulted primarily from erosion of a lithologically complex terrain and from deposition of sand dunes. The rolling terrain of Golden Gate Park and the moderate slopes in the central part of the city are due to weathering and subsidence of tremendous quantities of dune sand (Reference 3).

The Marin-Sonoma subregion displays the typical topography of the Coast Ranges, with gently rolling foothills and rugged, sharply dissected ridges at higher elevations. The intermountain valleys, Petaluma and Sonoma Valleys, consist of coalescing alluvial fans and floodplains and are among the largest valleys in the study area.

The mountain valleys of the Napa-Solano subregion are generally steep and are very susceptible to downslope movement of debris. The tidal areas and Delta region bordering Suisun Bay and Carquinez Strait occupy a large portion of the subregion and are used primarily for agriculture and grazing.

The Contra Costa subregion is dominated by the Diablo Range, consisting of smooth rolling hills to fairly rugged mountains. The San Francisco Bay depression and intermountain valleys are nearly level floodplains and low terraces.

The Livermore-Amador subregion lies within the Diablo Range. Most mountain valleys are young and V-shaped. South of Livermore Valley, the slopes are steep and the ridges narrow. The upland terraces south of Livermore Valley are characterized by smooth, wide ranges that dip at an angle of 10 to 30 degrees northward, and by steep V-shaped valleys. The intermountain valleys are coalescing alluvial fans, low terraces, and floodplains. The adjoining Livermore and Amador Valleys are the largest of the coastal valleys.

The East Bay subregion consists of two general physiographic regions: the Berkeley Hills and the Bay fill area. The Berkeley Hills are fairly steep hills with rounded ridges. Most mountain valleys are young and V-shaped. On the eastern flank of the hills landslides are very common, especially within the Orinda Formation, which consists of silt, clay, and sometimes sand and gravel. The western part of the East Bay subregion is the filled San Francisco Bay depression.

## B. ENVIRONMENTAL, SOCIAL, AND ECONOMIC SETTING

### 1. Physical Environment

a. Geology. The San Francisco Bay Region contains most of the geologic units present in the California Coast Ranges. These units have been folded and faulted into structures that are also typical of the Coast Ranges as a whole. Many rock types are represented, varying in lithology and in age. The oldest formation outcropping in the area is the Franciscan Formation, Jurassic in age (170 million years); the youngest rocks are Quaternary sediments (three million years or less).

The Franciscan Formation is a heterogeneous assemblage of volcanics, metamorphics, greywacke sandstones, and radiolarian cherts, without any stratigraphic continuity. It is at least 10,000 feet thick and may be as thick as 40,000 to 50,000 feet. The formation outcrops extensively in the Diablo Range of Santa Clara and Alameda Counties; exposures can also be found in the Santa Cruz Mountains west of Santa Clara Valley and south of San Jose, on the San Franciscan Peninsula east of the San Andreas fault zone, along the base of the Berkeley Hills, in the Mount Diablo area, over most of Marin and Sonoma Counties, and in scattered parts of Napa County (Reference 4).

The Great Valley Sequence overlies the Franciscan Formation in places. Probably 140 million years old, these sediments consist of sandstone with shale interbeds. The Sequence differs from the Franciscan Formation in the persistence of individual beds and the absence of small-scale, pervasive crumpling, fracturing, and shearing. The Great Valley Sequence is exposed primarily in the eastern part of the Bay Basin.

Unconsolidated sediments are primarily Late Pliocene (ten million years) to Holocene, and form the valley floors and the Bay muds in San Francisco (Reference 5). The deposits are predominantly dune sand and water-laid sand, mud, and clay. The thickness of the sediments varies from place to place; the broader valleys generally contain the thickest deposits. The centers of the Santa Clara, Livermore, and San Joaquin Valleys are more than 1,000 feet thick and up to 3,000 feet thick in some places. The sediments in the Bay proper are mostly soft clay and silt with minor amounts of sand and gravel, varying in thickness between 10 and 100 feet (Reference 32).

b. Seismic History. The nine Bay Area counties lie within a geologically active, young, dynamic part of the California Coast Ranges, one of the most seismically-active areas in the United States. The major active fault zones recognized in the Bay Region are the San Andreas, the Hayward, and the Calaveras. An active fault is one where displacement has taken place in historic time as evidenced by linear patterns or earthquake epicenters, or by surface slippage or creep along the fault trace (Reference 6).

Figure 5 shows the location of the active fault zones, all trending northwesterly. The San Andreas fault zone is near the western border of the Bay Region. Seismic activity along the fault is manifested by earthquakes varying in magnitude from 8.25 (the 1906 San Francisco earthquake) to about 5 on the Richter scale. In the East Bay, the Hayward fault zone is about 20 miles east of and nearly parallel to the San Andreas fault zone, and extends southeast from San Pablo Bay to Warm Springs. Its location northwest of San Pablo and southeast of Warm Springs is not definitely known. Recent evidence shows that tectonic creep has been occurring along this fault at a rate of one-half foot per 50 years since 1920. The Calaveras fault, a wide and complex zone, lies generally east of the Hayward fault zone, but may merge with it near or south of Calaveras Reservoir, and may join the San Andreas fault zone ten to fifteen miles southeast of Hollister. The Calaveras fault has not shown evidence of earthquake activity in recent history, but tectonic creep has been observed, especially near its southern end.

The Bay Basin accommodates a number of inactive faults (i.e., faults not active within the last 10,000 years); however, there is no reason to anticipate a reactivation of these dormant faults, and they are not considered as a potential hazard.

Although no strong earthquakes have occurred in the San Francisco Bay region since 1906, it is realistic to anticipate strong earthquakes and surface rupturing in and near the active fault zones. Such a possibility must be considered whenever major engineering projects are planned in this area.

c. Climate. The climate along the central California coast near San Francisco Bay is characterized by mild temperatures throughout the year, with small diurnal and annual ranges near the ocean and larger ranges further inland. Rainfall is concentrated in the period of November through April, which accounts for about 90 percent of the annual total. Winds are generally onshore, from the west through north, and are modified locally by terrain features. Severe weather is rare, usually occurring in the winter months in conjunction with frontal passage bringing high winds and heavy precipitation.

The center of the San Francisco Bay Area is a large, shallow basin ringed with hills that taper into a series of sheltered valleys (such as the Santa Clara, Livermore, Diablo, and Napa Valleys). This topography alone gives the area great potential for trapping and accumulating air pollutants. Within this basin contaminants are emitted at a fairly constant rate throughout the year. Pollution concentrations fluctuate widely from day to day and from season to season because of the weather.

Global-scale weather strongly affects these local variations. When strong jet-stream winds dominate the airflow above California, or when migratory storms bring rain and upward vertical flow, air

pollution concentrations are low. When high-pressure areas dominate California, resulting in light winds and downward vertical flow, heavy buildups of pollution are common. The amount of air available to dilute pollutants depends primarily on two factors, horizontal airflow and vertical mixing.

Vertical mixing is severely limited when a layer of warmer air lies above a layer of cooler air. This is a reversal of the atmosphere's normal decrease of temperature with altitude and is thus called an inversion. The strong inversions typical of California summers are caused by downward vertical motion, called subsidence, which compresses and heats the air. The surface inversions typical of winter are formed by radiation as air is cooled in contact with the earth's cold surface at night. Both types of inversion mechanism may operate at any time of the year; in autumn, both often combine to produce heavy pollution.

The important effect of a temperature inversion is to prevent pollutants from rising and being diluted vertically. Summer subsidence inversions persist throughout the day and occur more than 90 percent of the time. Winter radiation inversions occur on more than 70 percent of the nights but are usually destroyed by heating in the afternoon, bringing rapid improvement in air quality (Reference 7).

d. <u>Soils and Agricultural Capabilities</u>. Bay Region soils may be classed into three major categories: residual, inland valley, and recent alluvial (Reference 1).

Residual soils are those that have formed in place on consolidated bedrock through the processes of mechanical and chemical weathering. These soils, generally occurring on the steeper slopes throughout the region, tend to be shallow, are particularly susceptible to erosion, and are not practical for agricultural purposes.

Inland valley soils are fairly old, deposited soils with moderately- to highly-developed profiles. They have been subjected to elevation and later stream erosion, resulting in a characteristically rolling topography. Inland valley soils are generally well suited to cultivation.

Recent alluvial soils are found on floodplains, near stream channels, and on intertidal areas adjoining the Bay. Because these soils are still in a dynamic state, their profiles tend to be in the early stages of development. Soils in regions directly adjoining the coast are of low permeability, being composed of clay, clayey loam, and silt. The more inland alluvial soils generally have a higher permeability and are frequently used for commercial crop production.

Soils capable of agricultural production are shown in Figure 7. The soils are shown outside intensively-developed (urban) land

areas and range in quality from those with few limitations to those with characteristics restricting the choice of crops that may be cultivated. Not shown are soils with major to very severe limitations restricting their use largely to grazing, woodland, or wildlife food and cover. Agricultural soils are generally moderately to very deep, are nearly level to strongly sloping, and vary from well-drained loams to poorly-drained saline soils. The following descriptions to agricultural soils where crops are known to be produced commercially.

The areas immediately bordering the southern portion of the Bay contain fine-textured soils, influenced primarily by tidal waters. Moving inland, the region consists of deep, poorly-drained soils of recent alluvial deposit. Most of the remaining South Bay valley floor, drained by Coyote Creek and the Guadalupe River, is formed from moderately-drained, medium-textured alluvial plain soils. These are the major agricultural soils in the subregion and support extensive orchards. A less extensive soil group, composed of older alluvial fans and terraces, is found between the major valley floor area and the more mountainous regions to the west, which contain residual soils formed in place from the underlying bedrock.

In most of the San Mateo subregion, shallow, well-drained residual soils predominate. Clayey, tidally-dominated soils of low permeability and poor drainage characteristics border the Bay. Some areas along the Pacific Ocean, particularly near Half Moon Bay, have a gentler topography, and the consequently deeper soils support some farming and extensive horticultural activity.

A wide diversity of soil types occurs within the Marin-South Sonoma subregion. As with other subregions, lands bordering the Bay are predominantly fine-grained alluvial soils somewhat influenced by tides. The Petaluma River and Sonoma Creek are major drainage basins, and surrounding alluvial soils support a variety of agricultural and dairy activities.

Napa County is characterized by a number of major valleys separated by intervening ridges, resulting in rich alluvial soils in the drainage basins and shallower residual soils on the hillsides. The eastern portion of the subregion is covered by clayey tidal flats, usually water-saturated and of very low permeability.

The western and northern sections of the Contra Costa subregion bordering San Francisco, San Pablo, and Suisun Bays are dominated by tidal flats and mud, often saturated and poorly drained. Much of the soil in western Contra Costa County is clayey loam, suitable for agricultural or pasture use, although major portions have been covered by urban growth. Prime agricultural soils, mostly shallow loams and clayey loams, are found in eastern Contra Costa County.

The Livermore and Amador Valleys cover a small area in the northern portion of the Livermore-Amador subregion where the valley alluvial clayey loams support vineyards.

Three major soil groups, roughly forming three north-south strips, cover the East Bay subregion. On the western side, abutting the Bay, tidal flats and near-shore areas are represented by clayey and fine-grained soils of low to moderate permeability. Further inland is a strip of deep clayey loams with moderate permeability. This grades into the eastern strip of soil covering the Pleasanton, Sunol, and Walpert Ridges. This is a moderately permeable clayey loam tending to be shallower than the soil to its west due to its higher erodibility.

e. Mineral Resources. The major resources recovered in the Bay Area are construction materials, such as limestone and oyster shells (used in the manufacture of cement), sand and gravel, and crushed stone; energy sources, such as gas, oil, and geothermal power; and salines (Reference 8). These commodities account for more than 90 percent of the Bay Area's mineral products. Virtually all are used within the Bay Area. In contrast, most of the mercury recovered from Bay Area ores has been exported.

Minerals quarried in the Bay Area for use in the building industry have an annual value of more than $70 million and account for more than half of the total value of mineral products produced in the area. Because of their bulk and low unit value, they are generally mined as close to the point of use as possible. This category includes vast quantities of sand and gravel, crushed stone, and limestone and shells. Because these products are needed in huge amounts, are mined at the surface in large quarries, and have unit values that are small compared with transportation costs, their use entails serious environmental and economic problems and requires considerable planning.

The other mineral commodities formerly and currently produced in the Bay Region do not require an extended discussion since they are not likely to be utilized. Several mineral products that were recovered earlier will probably not be produced again in the near future, chiefly because of changed economics and greater availability elsewhere. In this category are asbestos, chromite, coal, copper, magnesite, manganese, and pyrite.

f. Hydrology. (The principal oceanic, estuarine, and inland surface water resources are shown in Figure 4). The Pacific Ocean forms the western boundary of the San Francisco Bay basin and directly affects the San Mateo, San Francisco, and Marin-Sonoma subregions. The large-scale movement of ocean waters near the central coast, resulting in the final dispersal of all pollutants entering either directly from coastal sources or from the Bay through the Golden Gate, is controlled by tidal movements and currents.

The San Francisco Bay system forms one of the world's major estuaries (Reference 9). Before the onset of intensive human activity in the area, the Bay's area was nearly 700 square miles, including 300 square miles of marshland. In the last hundred years, most

of this marshland has been reclaimed for agricultural and salt-pond use or filled for development. The Bay at mean tide currently includes an area of about 435 square miles.

The Sacramento-San Joaquin Delta has a major effect on the hydrology of San Francisco Bay. More than 1,100 square miles in area, the Delta is roughly triangular, extending from Chipps Island near Pittsburg on the west, north to Sacramento, and south to a point about ten miles southeast of Tracy. Before development started in the Central Valley, the annual Delta outflow into the Bay was about 30 million acre-feet per year. The average annual outflow is now about 18 million acre-feet. The management of the Delta waters has an extremely important impact on the hydrologic characteristics of the Bay and remains an unresolved and controversial question.

The Delta, at the eastern end of Suisun Bay, is the entry point of the Sacramento and San Joaquin Rivers into the Bay system and contributes virtually all of the fresh-water streams. Characteristically, these are highly seasonal in flow; more than 90 percent of the average flow occurs during winter, and many of the smaller streams dry up in late summer.

The net horizontal movement of ground water through the entire Bay system is affected by exchanges with fresh water in aquifers adjacent to the bays. Nine distinct ground-water basins are recognized and are shown in Figure 4. Their respective storage capacities are summarized in Table 15.

The maximum ground-water recharge rate under natural conditions is limited to the rate of infiltration and percolation of the water precipitated over or transported across the recharge areas by flowing streams. Therefore the maximum natural yield of the aquifers must be relatively limited.

The quality of the ground water in the study area is generally good to excellent, especially around Suisun Bay and Marin-Sonoma. The South Bay has experienced problems with overdrafting the ground water, resulting in saline water intrusions, land subsidence, and lowering of the ground-water table.

In southern Santa Clara Valley, continental deposits overlain with alluvial deposits form two major aquifers. Along the valley fringes the aquifers are composed of gravelly and sandy alluvial-fan deposits; near the center they are fine-grained floodplain deposits interspersed with gravelly channel deposits. Near San Jose the aquifers are 800 feet thick, with a base some 1,500 feet below sea level.

Presumably, the major ground water recharge of the southernmost aquifer takes place at the head of the alluvial fans of the tributaries to Guadalupe, San Francisquito, and Stevens Creeks, as well as at the channel of Coyote Creek southeast of San Jose.

TABLE 15
GROUND WATER BASINS
WITHIN THE BAY-DELTA SYSTEM

| Ground-Water Basins | Gross Storage Capacity (1,000 Acre-Feet) |
|---|---|
| Petaluma Valley | 200 |
| Napa Valley | 250 |
| Sonoma Valley | 190 |
| Suisun-Fairfield Valley | 230 |
| Santa Clara Valley | |
| Fremont | 1,360 |
| North Santa Clara | 1,900 |
| Livermore Valley | 400 |

Source: Reference 9.

The ground-water basin in northern Santa Clara valley has been subjected to serious overdraft beginning in the 1930s, resulting in ground subsidence, saline water intrusion around the Bay, and gradual deterioration of ground-water quality in parts of the basin. The Santa Clara Valley Water District has undertaken such mitigating measures as water recharge programs, which have resulted in a small rise in the water table in recent years (Reference 10).

The eastern part of the San Mateo subregion is part of the Santa Clara Valley ground-water basin; the ground-water characteristics are the same as discussed above. The western part of the subregion has no large underground storage basin. Most of the wells yield only 15 to 100 gallons per minute. In some places the water is too saline for agricultural use; however, water supply is sufficient for domestic and livestock use in this area.

The principal Marin-Sonoma aquifers occur in the alluvial plains in Petaluma and Sonoma Valleys. The depth of the Petaluma aquifer varies from 75 to 150 feet on the valley floor and from 75 to 250 feet near the Bay. The Sonoma aquifer consists of alluvial deposits of Holocene age. It appears to continue southward below San Pablo Bay, where it is covered by relatively impermeable layers of clay and mud. This aquifer reaches from San Pablo Bay north to one mile south of Glen Ellen.

Water from the Petaluma Valley ground-water basin is generally a calcium bicarbonate type of good quality. High salinities in the southern part of the basin appear to result from downward movement of shallow brackish waters rather than from intrusions of water from the Bay. Sonoma Valley ground water is generally a sodium bicarbonate or sodium chloride type and is satisfactory for most uses.

The principal aquifers in the Napa Valley basin are of the same nature as those in Sonoma Valley. The aquifers of the southern part of the Napa-Solano subregion are of old alluvial and continental deposits underlying the alluvial plains of the Fairfield and Green Valleys. The aquifers vary in depth from 60 to 200 feet.

The ground water quality in Napa Valley is similar to that in Sonoma Valley. The Suisun-Fairfield Valley basin's water is generally hard, slightly alkaline, and of either calcium or sodium bicarbonate type; it is suitable for most uses (Reference 1).

In the northern part of the Contra Costa subregion near Suisun Bay, layered deposits of sand and gravel separated by thick layers of silt and clay form an aquifer having a base depth of less than 200 feet and a general bayward dip. A part of this aquifer is exposed directly to the Sacramento River.

The Tehama Formation of semiconsolidated continental sedimentary rocks outcropping in the foothills along the south shore of Suisun Bay might constitute an aquifer. Its thickness ranges from 500 to 1,000 feet. The general movement of ground water in this region is bayward; the aquifers are recharged by upland percolation of precipitation.

Excessive industrial and municipal ground-water overdrafts in the past have induced infiltration of lower-quality waters from the adjacent river. Water imported from the Contra Costa Canal presumably has alleviated the situation. Ground water underlying the Pittsburg Plain is no longer used due to poor mineral quality; water from Clayton Valley aquifers are of generally good to excellent quality for irrigation although, because of excessive hardness they are usually softened for domestic and some industrial uses. Ground water underlying Ygnacio Valley is of generally poor quality, and its use has declined since construction of the Contra Costa Canal.

The Livermore Valley principal basin aquifers cover about 170 square miles. Portions of the basin have been overpumped for many years, with the result that water tables in several subareas have declined 75 feet from historic levels and that the water pumped has been of increasingly poor quality. Water for recharge imported from the South Bay Aqueduct has improved the water quality and raised the ground-water levels in some areas in recent years.

Three distinct aquifers occur in the East Bay, extending from Irvington in the south to the San Leandro-San Lorenzo area in the north. Each aquifer is separated from the others by impermeable blue clay layers; all are wedge-shaped, being relatively thick inland and tapering off toward the Bay.

The uppermost, or Newark, aquifer has a maximum base depth of 175 feet in the Niles cone area and 150 feet in the San Lorenzo-San Leandro area. The principal access of brackish Bay water into the Newark aquifer is believed to be near the Dumbarton Bridge. In the Niles cone area, the chloride concentration of the Newark aquifer has been increasing almost geometrically with time since 1920 (Reference 10).

The middle, or Centerville, aquifer has a base depth of about 240 feet and a thickness of 60 feet in the Niles cone area, and a depth of about 250 feet and a thickness of 100 feet in its northern part.

The lowest, or Fremont, aquifer has a base depth of about 300 feet and is about 50 feet thick in the Niles cone area.

The Alameda County Water District operates recharge basins in gravel pits to percolate natural runoff and imported water from Alameda Creek into the ground-water basin. This program has resulted in the maintenance of existing water quality, a rise in ground-water levels in the upper parts of the basin, and a possible decrease in the rate of saline water intrusion into the lower reaches adjacent to the Bay.

g. Flood Potential. The possible flooding of lands adjacent to the Pacific Ocean, San Francisco Bay, and the streams and rivers in the Bay basin represents a hazard to any sludge management process located on these floodplains. The location of sludge disposal sites, including landfills and dedicated land sites in known floodplains, would be of primary concern. The U.S. Department of Housing and Urban Development discourages certain types of development on areas within the 100-year floodplain; these areas are shown in Figure 4 (Reference 11). Current State requirements stipulate that landfill dosposal sites must be protected from the 100-year flood (Reference 12). Legislation does not affect the agricultural use of floodplains; indeed, much of the regions' prime agricultural land occurs on floodplains as a result of fluvial activity.

h. Noise. Noise has become an increasingly important problem int the Bay Area as population, urbanization, and transportation systems have grown. Noise levels are generally determined by density of development and distance to transportation facilities or industrial sites. Thus sparsely developed and rural areas have the lowest levels, and the highest levels obtain in the highly urbanized population centers. Typical sound levels of various common noise sources are shown in Table 2.

Transportation systems are the largest noise generators in the Bay Area. Airports are a major noise source affecting the land use of surrounding areas. Automobile traffic is a dominating noise source in both urban and suburban areas. San Francisco Bay is ringed with freeways, and the study area is criss-crossed with major highways, expressways, and arterials, all of which affect nearby land uses for a considerable distance. A more localized transportation noise source is railroads. Major rail routes follow the San Francisco peninsula and the east shore of the Bay.

Major stationary noise sources include foundries, shipyards, and other heavy industries. These sources are concentrated along transportation routes within the heavy-industry areas of San Francisco, Oakland, Emeryville, and north Contra Costa County.

There is no regional agency for noise control in the Bay Area. There are Federal and State regulations on noise from specific sources such as airports and highways. Most cities and counties have developed individual noise control strategies, usually embodied in local ordinances or general plans. Noise standards are not uniform, and the enforcement and effectiveness of local noise controls vary.

These noise control strategies fall into two major categories. Qualitative noise controls do not specify unacceptable noise levels but require abatement of specific noise sources that cause complaints from citizens. Quantitative noise controls specify maximum noise exposures for different land uses. Often these levels are used as goals or planning guidelines, with no legal basis for their enforcement.

TABLE 2
TYPICAL SOUND LEVELS MEASURED
IN THE ENVIRONMENT AND IN INDUSTRY[1]

| | Decibels, A-Weighted | |
|---|---|---|
| Civil Defense Siren (100')[2] | 140 | |
| Jet Takeoff (200') | 130 | |
| | 120 | |
| Riveting Machine | 110 | Rock Music Band |
| Emergency Engine-Generator(6') DC-10 Flyover (700') | 100 | Pile Driver (50') |
| Textile Weaving Plant Subway Train (20') | 90 | Boiler Room Printing Press Plant |
| Pneumatic Drill (50') | 80 | Garbage Disposal in Home (3') Inside Sport Car, 50 mph |
| Freight Train (100') Vacuum Cleaner (10') Speech (1') | 70 | |
| | 60 | Auto Traffic Near Freeway Large Store Accounting Office |
| Large Transformer (200') | 50 | Private Business Office Light Traffic (100') Average Residence |
| | 40 | Minimum Levels, Residential Areas |
| Soft Whisper (5') | 30 | |
| Rustling Leaves | 20 | Recording Studio |
| | 10 | |
| Threshold of Hearing in Youths (1,000-4,000 Hz) | 0 | |

[1]Adapted from Reference 14, p.9.

[2]The distance (in feet) between the source and listener is shown in parentheses.

The California Occupational Safety and Health Act of 1973 limits the noise exposure of employees at commercial and industrial sites. It also requires that any new facility be built with all feasible noise control measures to reduce noise below the noise exposure limits set by the Act. If such controls fail to reduce sound levels below these limits, personal protective equipment such as ear plugs must be provided to employees. The permissible noise exposures are shown in Table 3.

2. Biotic Environment

a. Flora and Fauna. In selecting sites suitable for use in wastewater solids management, consideration must be given to existing vegetation as well as potential natural vegetation that will develop if human influences are removed. The natural vegetation of the San Francisco Bay Region can be categorized as follows (Reference 13):

Grasslands
1) California steppe (*Stipa*, perennial grass)
2) Tule marshes (*Scirpus*, *Typha* - rushes, cattails)
3) Fescue oatgrass (*Festuca* - fescue)

Shrub habitats
4) Coastal sagebrush (*Salvia*, *Eriogonum* - sage)
5) Chaparral (*Ceanothus* - deer brush)

Needleleaf (coniferous) forest
6) Redwood forest (*Sequoia*, *Pseudotsuga* - redwood, fir)

Broadleaf and needleleaf forest
7) California mixed evergreen (*Quercus*, *Arbutus*, *Pseudotsuga* - oak, madrone, fir)
8) California oakwoods (*Quercus* - oak)

Two centuries of human influence have drastically altered the natural vegetative setting of the Bay Area, and only remnants of truly natural lands exist. The major influences affecting vegetation have been grazing, introduction of nonnative species, agriculture, and, more recently urbanization.

Today the classifications of vegetative type are virtually the same. With the exception of the grasslands (which are now dominated by annual rather than perennial species), most of the ecosystems still maintain the same dominant species. Figure 6 portrays the existing vegetative habitats. In comparing these to the potential vegetation categories, tule marshes are comparable to marshland and California steppe is referred to as grassland. Coastal sagebrush is considered under chaparral, and mixed evergreen and oaklands are shown as hardwood forests. New categories are barren, cultivated/pasture, and urban/industrial.

In general, coniferous forests are found only along the north- and west-facing slopes on the western side of the Coastal Ranges or in moist fog-laden valleys in Marin and San Mateo Counties. Oak forests include laurel, buckeye, and madrone trees and are frequently

TABLE 3
PERMISSIBLE NOISE EXPOSURES SET BY THE CALIFORNIA OCCUPATIONAL SAFETY AND HEALTH ACT OF 1973

| Duration Per Day Hours | Sound Level A-Weighted Decibels |
|---|---|
| 8 | 90 |
| 6 | 92 |
| 4 | 95 |
| 3 | 97 |
| 2 | 100 |
| 1½ | 102 |
| 1 | 105 |
| ½ | 110 |
| ¼ or less | 115 |

Source: Reference 15.

interspersed with grasslands. Along streams, alders, willows, and sycamores predominate. Chaparral occurs on poor soils, mixed with oak forests, and on dry hillsides. Inland from the hills surrounding the Bay and on coastal terraces near the Bay, the land forms are dominated by extensive grasslands, most of which are extensively grazed.

Wastewater solids management activities will be essentially confined to terrestrial sites not adjoining wetland areas. The common species of animals most likely to be affected by these activities are black-tailed deer, which range throughout the Bay Area; small upland mammals such as cottontail, brush rabbit, jackrabbit, and western gray squirrel, which are plentiful throughout the foothills and woodlands; California quail and mourning dove, the chief upland game birds of the Bay Area, and more than 100 species of songbirds occupying various habitats. Other, less common, upland fur-bearers include the coyote, gray fox, badger, skunk, opossum, weasel, and bobcat.

Many species of amphibians and reptiles inhabit the Bay Region, including frogs, toads, and salamanders, which require permanent fresh-water habitat. Other common species are the California newt, California slender salamander, western toad, western fence lizard, gopher snake, common king snake, and several species of racer.

Figure 6 shows the locations of wildlife refuges and preserves.

b. <u>Endangered Species</u>. The California Native Plant Society's listing of rare and endangered plants (Reference 16) includes a large number of species found throughout much of the study area. Many of these plants are wetland related and therefore should not receive direct impact from the Wastewater Solids Study, the disposal sites for which will not include or adjoin important wetlands. A total listing of these plants, the locations of which are shown on 7½ minute quadrangle maps available from the Society, is considered inappropriate for a general, regional setting. In the course of evaluating each proposed site, however, EIP will list any rare or endangered plant that could be affected by the project.

Table 4 lists rare and endangered species that could be affected by wastewater solids management practices in the Bay Area. Wetland-dependent species have not been listed since disposal/use sites will not be located adjacent to wetlands.

Species listed in Table 4 may occur on terrestrial sites and are accorded varying degrees of protection depending on their status (References 17, 18). Federal funding could be curtailed for projects having significant adverse impacts on habitat known to be used by species listed as threatened (Reference 17). Habitats used by species listed as rare or fully protected (Reference 18) should be avoided.

TABLE 4
RARE AND ENDANGERED SPECIES
IN THE SAN FRANCISCO BAY AREA

| Common Name | Scientific Name | Reference 8 | 11 | 5 | 4 |
|---|---|---|---|---|---|
| Birds | | | | | |
| Prairie falcon | Falco mexicanus | | T | | |
| American peregrine falcon | Falco peregrinus anatum | E | T | E | F |
| In addition, all shorebirds are protected. | | | | | |
| Reptiles | | | | | |
| Alameda striped racer | Masticophis lateralis euryxanthus | | | R | |
| San Francisco garter snake | Thamnophis sirtalis tetrataenia | E | T | E | F |

T = Threatened R = Rare
E = Endangered F = Fully protected

Source: Reference 1.

c. Sensitive Ecological Areas. Within the Wastewater Solids Study planning area, some parcels of land contain assemblages of plants, animals, and physical features that set them apart. Most of these areas retain their original natural values much as they have existed for centuries. Because of the interrelationships among the waters, soils, plants, and animals, disturbances to any one element can cause changes in other elements that depend directly or indirectly on the affected element. Because of these unique assemblages and dependencies, such areas are considered to be ecologically sensitive. More than other areas, they are susceptible to adverse impacts from changes in land use.

Sensitive ecological areas are associated primarily with coastal areas, wetlands, and streams (Figure 6). For the purposes of this study, wildlife preserves and refuges and critical habitat for endangered species are also considered to be ecologically sensitive.

3. Human Environment

a. Economic Activity. The outstanding characteristic of the San Francisco Bay Region's economy is its role as the west coast center for finance, administration, and trade. This economic influence extends far beyond the immediate area and encompasses all the western states. The largest single feature of the region's economy is the combined economic effect of all the individual service activities associated with a large urbanized area.

Manufacturing ranks second in the economy of the Bay Area and until recently was substantially diversified, tending toward light industry, development of the state's natural resources, and the financial and commercial activities of regional urban centers. This balance has been altered in recent years with the addition of defense-oriented manufacturing plants in the southern part of the region.

Recent industrial growth around the Bay has included oil refineries, explosives manufacture, food processing and packaging plants, a highly-developed construction materials industry, and the manufacture and fabrication of a variety of other products. The outlying portions of the region are under intensive agricultural development, following the general pattern of the interior valleys of the state.

Increased economic development provides the stimulus for higher levels of employment, which in turn result in growth of the resident population. Table 16 shows the Bay Area's employment by major economic sector. Employment statistics developed by the Association of Bay Area Governments (ABAG), the regional planning agency, form the foundation for employment data presented below. Modeling procedures used in determining employment levels distinguish between two types of employment: basic and population-serving. The basic sector of employment includes industries producing or processing materials and goods mainly for export out of the area, or for intermediate use by other local firms. The population-serving sector provides consumer goods and services to the population within the Bay

TABLE 16
EMPLOYMENT IN MAJOR ECONOMIC SECTORS

| Sector | 1960 | 1970 |
|---|---|---|
| Agriculture | 35,800<br>2.5% | 27,400<br>1.4% |
| Mining | 2,300<br>0.2% | 2,500<br>0.1% |
| Construction | 96,400<br>6.7% | 121,300<br>6.1% |
| Manufacturing | 294,700<br>20.4% | 374,300<br>18.7% |
| Transportation, Communication, and Utilities | 119,900<br>8.3% | 142,000<br>7.1% |
| Wholesale and Retail trade | 305,500<br>21.7% | 404,000<br>20.2% |
| Finance, Insurance, and Real Estate | 88,500<br>6.1% | 133,800<br>6.7% |
| Services | 260,500<br>18.1% | 413,000<br>20.7% |
| Government | 238,700<br>16.6% | 380,600<br>19.0% |
| Total Employment | 1,442,300<br>100.0% | 1,999,100<br>100.0% |
| Basic, or Site-Oriented Employment | 684,800<br>47.5% | 921,400<br>46.1% |
| Population-Serving Employment | 757,500<br>52.5% | 1,076,800<br>53.9% |

Source: Reference 33.

Area. Industries included in the population-serving category include business establishments such as retail trade or personal and business services.

To provide the input essential in forecasting waste generation in the 1975 Water Quality Control Board Study, the Regional Water Quality Control Board modified the basic data supplied by ABAG. Although the total employment for the nine-county area was retained, the distribution of employment was shifted to reflect more reasonable commuting times for workers. The approach for this revised allocation was based on the planning work of the Bay Area Transportation Study Commission. In effect, this shift in employment distribution causes greater increases in employment for the northern counties of Solano, Sonoma, Napa, and Marin. This difference is balanced largely by lower growth rates in employment for both Alameda and Santa Clara counties.

The second revision to the basic data, which is more closely related to the capacity for waste generation, occurs in the allocation of employment between basic and population-serving classifications of employment. Wastes generated by basic industries differ significantly in magnitude and character from municipal wastes. Population-serving employment is obtained by subtracting the total number of employees involved in manufacturing from the total employment figures supplied by ABAG.

Further adjustments were made to exclude sales and office personnel from the manufacturing categories. The resulting 1970 employment distribution by county, which serves as the 1970 base line for projecting employment in the area, is presented in Table 5. The basic employment figure includes only the number of workers engaged in actual production. The 1975 employment figure was developed by ABAG and is also shown in Table 5.

The economic well-being of residential, commercial, and particularly industrial activity is strongly related to the availability of adequate and economical sources of water, energy, and other services rendered by the metropolitan infrastructure. Historically, these demands have been supplied to a large extent with economical fresh-water supplies from outside the basin, readily available cooling waters from the Bay and estuary, and energy in the forms of gas and electrical power furnished by Pacific Gas and Electric Company.

Areas forecast to experience the most rapid growth in manufacturing are the eastern and northern counties. More conservative estimates of increases in production are predicted for the western counties. Changes in level of industrial production are lowest in San Francisco, where reductions in most categories are anticipated. This is due primarily to a shift in employment toward service industries such as financial institutions, wholesale trade, transportation, and corporate offices, as well as government services. Southern counties are expected to experience an increase in production in almost all industrial categories. Additional information is presented in Reference 1.

TABLE 5
BASE-LINE EMPLOYMENT DISTRIBUTION, 1970, 1975

| County | 1970 | | | 1975 | | |
|---|---|---|---|---|---|---|
| | Population-Serving | Basic | Total | Population-Serving | Basic | Total |
| Alameda | 356,274 | 101,173 | 457,447 | 224,162 | 210,107 | 434,270 |
| Contra Costa | 112,394 | 24,527 | 136,921 | 102,385 | 57,672 | 160,057 |
| Marin | 47,120 | 3,577 | 50,697 | 39,882 | 15,846 | 55,728 |
| Napa | 23,144 | 2,473 | 25,617 | 18,685 | 9,945 | 28,630 |
| San Francisco | 440,849 | 57,632 | 498,481 | 260,052 | 235,354 | 495,406 |
| San Mateo | 185,949 | 30,367 | 216,316 | 119,449 | 105,681 | 225,130 |
| Santa Clara | 297,729 | 120,995 | 418,724 | 254,869 | 262,881 | 517,750 |
| Solano | 39,378 | 3,358 | 42,736 | 27,582 | 24,711 | 52,293 |
| Sonoma | 12,398 | 1,658 | 14,056 | 48,225 | 29,069 | 77,294 |
| Total | 1,515,235 | 345,760 | 1,860,998 | 1,095,292 | 951,266 | 2,046,558 |

Source: References 1 and 19.

b. Housing Supply. Housing factors relating to wastewater solids management include the possible effects any management plan would have on the supply and demand for housing; the types of plumbing facilities in existing housing (running water, toilets, septic tanks, etc.); and the effect of a treatment of disposal facility on the quality of housing nearby.

In the past decade, more than a million and a half people have moved to the Bay Area, a population increase of over 20 percent. The existing housing stock in the nine counties cannot accommodate the demand for new housing, and all counties are feeling the pressure to increase the housing supply. Between 1970 and 1975, Alameda County increased its number of units from 365,000 to 403,000; Contra Costa County from 172,950 to 204,600; and San Mateo County from 185,000 (Reference 20). The number of units in San Francisco, however, decreased from 295,200 to 293,000, due to redevelopment and the abandonment of inadequate units.

Most of the housing stock in the Bay Area is adequate in terms of running water and plumbing. In six of the nine counties, less than one percent of the housing stock lacks some plumbing facilities.

c. Health and Safety. For the purposes of this task report, health and safety aspects are defined as health hazards emanating from heavy metals, persistent organic compounds, and microbiological contaminants. Health problems related to air and water pollution are important enough to warrant separate consideration and are discussed in the sections on air quality and water quality.

This task report provides a regional overview of general background environmental conditions in the Bay Area. Health hazards from heavy metals, organic substances, and pathogens, however, are confined to specific sites. Except for some landfill disposal sites, the Bay Area does not encompass any areas presenting significant health hazards in this regard. Exceptions would be small, individual areas where pesticides may have been spilled or misused, where septic tanks are improperly operated, or where shellfish are contaminated. These have little bearing on concerns related to wastewater solids.

A discussion of this topic is deferred to Task 3-7.6 (Analysis of Site-specific Project Alternatives), to be prepared after the disposal and land application sites have been identified. Regional regulations on health hazards are discussed in Task 3-7.4 (Background Social Impact Factors).

d. Sense of Community. For the purposes of the Wastewater Solids Study, the discussion of community character will review the more common indicators, which can be measured and compared from one area to another. A brief review of some basic demographic information for each of the nine counties can provide a background on a

macro-level of the study area; the data can be refined when examining the specific areas under consideration in the planning of wastewater solids disposal/use options.

The enormous expansion of most Bay Area communities over the last two decades and the relatively short time over half the residents have lived in their particular dwelling (owned or rented) may have ramifications for the long-range planning of waste disposal. Four demographic indicators that can be considered as contributing to a sense of community are population (discussed in a separate section above), education, family income, and employment.

All residents of the nine-county area appear to place a premium on education. More than 60 percent of the population have completed high school, and almost 10 percent have four years or more in college. Table 17 shows the median education for people 25 years or older, the percentage who completed high school, and the percentage who had at least four years of college. Presumably, communities with a higher percentage of residents with a college education may be more directly concerned with treatment of wastewater solids and could be more involved with the Wastewater Solids Study.

The Bay Area's rapid growth over the last two decades has been stimulated by prospects of good jobs, business opportunities, and high standards of living. Table 6 shows the ranking of family income within the nine counties, the percentage below the poverty level, and the percentage earning more than $15,000.

Marin County had the highest average family income and one of the lowest percentages of families below the poverty level. Solano County had the lowest family income of all the Bay Area counties, and one of the highest percentages of families below the poverty level. Although San Francisco ranked in the lower 25 percent of the counties in terms of family income and had one of the highest percentages of families below the poverty level, it had the highest individual net income per capita, perhaps because of the large number of single people employed in the city.

Property owners with annual family incomes above $15,000 may have a greater interest than the rest of the population in the wastewater solids planning process and in the probable cost to their respective communities.

Table 7 shows the rank of unemployment within the counties. The nation's economic recession was felt in the Bay Area, and unemployment rates have increased annually in all counties for the last five years. Solano and Sonoma Counties had the highest unemployment percentages; their bordering county, Napa, had one of the lowest. Marin and San Mateo Counties, with the highest family income, had the lowest percentage of unemployment.

TABLE 17
EDUCATION

| County | Median Years of Education Completed | % Completed High School | % 4 Years College or More |
|---|---|---|---|
| Alameda | 12.4 | 63 | 15 |
| Contra Costa | 12.5 | 68 | 17 |
| Marin | 12.9 | 79 | 27 |
| Napa | 12.4 | 63 | 11 |
| San Francisco | 12.4 | 62 | 17 |
| San Mateo | 12.6 | 72 | 17 |
| Santa Clara | 12.6 | 69 | 20 |
| Solano | 12.3 | 63 | 9 |
| Sonoma | 12.4 | 64 | 11 |

Source: Reference 22.

TABLE 6
FAMILY AND PERSONAL INCOME, 1970

| County | Rank of Family Income for Study Area | % Below Poverty Level | % Above $15,000 | Rank of Net Personal Income for Study Area |
|---|---|---|---|---|
| Alameda | 5 | 8 | 28 | 4 |
| Contra Costa | 4 | 6 | 35 | 6 |
| Marin | 1 | 5 | 44 | 3 |
| Napa | 6 | 8 | 24 | 9 |
| San Francisco | 7 | 10 | 27 | 1 |
| San Mateo | 2 | 4 | 39 | 2 |
| Santa Clara | 3 | 6 | 35 | 5 |
| Solano | 9 | 9 | 20 | 7 |
| Sonoma | 8 | 10 | 20 | 8 |

Source: Reference 21.

TABLE 7
UNEMPLOYMENT

| County | Rank-Highest Unemployment Percentage |
|---|---|
| Alameda | 3 |
| Contra Costa | 6 |
| Marin | 8 |
| Napa | 7 |
| San Francisco | 4 |
| San Mateo | 9 |
| Santa Clara | 5 |
| Solano | 1 |
| Sonoma | 2 |

Source: Reference 22.

e. Equity. From the economic perspective, equity can be measured in terms of the costs and benefits of a particular program/service to the consumer.

Consumer surplus is a concept of welfare economics that considers the difference between the total value of a product (including the subjective benefits the consumer receives) and the market value or marginal cost. In planning for the "common good", one should consider the level of consumer surplus and how it would be affected by the project. This concept is rather complex, since it entails the dollar determination of such benefits as freedom of movement, aesthetics, personal satisfaction, etc. (Reference 34). In applying this concept to the Wastewater Solids Study, the benefits of the disposal/use "service" would presumably exceed the marginal cost (i.e., there would always be consumer surplus), since the service is needed by the public.

The concept of equity applied to social science research generally refers to the opportunities available to the population to enhance their quality of life. Education, job training, and employment are the basic focal areas in determining the level of equity that exists in a given community. Opportunities to obtain higher education and employment commensurate to an individual's skills should be available to all sections of society: the handicapped, minority youth, low-income groups, etc. In a competitive economic and social system, the special population groups are not always offered the same opportunities for education and job advancement as the public at large.

All nine counties of the Bay Area are subject to a multitude of Federal, State, and County regulations on equal employment opportunities, social services for special population groups, and anti-discrimination practices. Yet unemployment is higher in the nine counties than the average for the rest of the country. Critical social services have been curtailed due to a cutback of public funds, and continued pressure is exerted at the local, county, State, and Federal levels to expand old programs and develop new ones for increasing the educational and employment opportunities for all segments of society in the Bay Area.

The public is concerned about improving the level of equity in the nine counties. School bond issues to expand educational facilities are on nearly every election ballot. Elected officials claim that alleviation of unemployment is a top priority.

In developing a regional wastewater solids plan, the impact on individual opportunity is an area of critical interest. Any project proposed by the plan should have provisions to insure equal employment opportunities for all population groups. The process of selecting disposal/use options should include an examination of the relative cost/benefit (i.e., level of consumer surplus) to insure that the most "equitable" method available to the public is implemented.

## 4. Historic and Archaeological Setting

There is no central repository for the registered historic and archaeological sites found in the Bay Area. Rather, the sites are designated by a variety of local, municipal, county, academic, State, and Federal groups and agencies, including:

Federal: National Register of Historic Places

State: Historic Landmarks Advisory Committee
Department of Parks and Recreation, Office of Historic Preservation

County: Alameda County Planning
San Francisco Landmarks Board
Marin Heritage
Santa Clara County Landmark Program
Napa Architectural Heritage
Napa Redevelopment Agency
Sonoma League for Historic Preservation
Contra Costa County Planning Department

Local: Livermore Heritage Guild
Napa Community Redevelopment Agency
San Francisco Heritage
Berkeley Landmark Board
Berkeley Architectural Heritage Association

Archaeological sites are listed in regional clearinghouses located at the following academic institutions:

San Francisco State College
Aptos College
Sonoma State College
Cabrillo College
University of California, Davis

## 5. Visual Amenities

Visual amenities may be categorized as coastal viewshed, highly scenic areas, and open areas with particular value in providing contrast to urbanization or in preserving natural land forms.

Included in the coastal viewshed are coastal lands and waters that can be seen from coastal highways and access roads, trails, railroads, public vista points, recreation areas, the water's edge. These subcategories can also be used for evaluating the visual amenities of the Bay. Highly scenic areas include ridges, oak woodland and redwood concentrations, agricultural valleys, and landscape preservation projects. Open areas are particularly valuable in the heavily urbanized San Francisco Bay Region. These open-space areas are important resources and must be balanced with development.

Also included in visual amenities is the visibility impact of clean air. Air pollution causes a visibility problem, particularly in the East Bay and the South Bay-San Jose area. It is important to preserve the existing air quality and visual quality and it is desirable to improve it.

The urban landscape of the Bay Area is an important asset. San Francisco is recognized by many as one of the most beautiful cities in the United States. Its visual quality should be maintained. The Oakland-Berkeley, Palo Alto, and San Jose-Santa Clara areas are also important elements of the Bay Region's urban landscape.

## 6. Energy

Most of the electricity and natural gas used in the San Francisco Bay Region is supplied by Pacific Gas and Electric Company (PG&E). PG&E generates electricity from a variety of sources. In 1975, the most recent data available, 33 percent of the electricity was generated from hydroelectric power plants, all located on the western side of the Sierra Nevada mountain ranges in California outside of the study area. Three percent of PG&E's peak-period electricity was generated by a pump storage unit. Forty-two percent of PG&E's electricity was derived from fossil fuel-fired plants, the majority of which are located within the Bay Area. Nuclear power plants provided 6 percent of PG&E's electrical generating capacity. Geothermal power plants supplied 3 percent of PG&E's electricity; they are located immediately outside of the study area in northern Sonoma County.

To meet the anticipated increased demand for electricity in Northern California, PG&E proposes to increase its electrical capacity by some 66 percent over the ten-year time period through 1975-1985. Reliance on hydroelectric power will be reduced from 41 to 31 perdent. The percentage of nuclear power within the system will increase from 3 percent to 16 percent; geothermal power will increase from 3 to 8 percent; pump storage will increase from 3 to 7 percent. From 1986 through 1995, PG&E plans to increase its capacity by another 64 percent. Reliance on hydroelectric power will be reduced to 17 percent of the total. Ten percent of peak demand will be met by means of pump storage power. Oil and gas-fired plants will supply 12 percent of the total energy. Nuclear power will greatly increase, supplying 49 percent of the total power requirements. The number of gas turbine power plants, (peaking units) will increase to supply 6 percent of the total power. Geothermal power will also be increased and supply 6 percent of PG&E's total power supply.

The major changes involved in PG&E's proposed system increments are a drastic change from reliance on hydroelectric power, a large decrease in reliance on straight fossil-thermal plants, a large increase in reliance on nuclear power, and an increase in the number of geothermal power plants. No forecasts are available beyond 1995,

and given the uncertainty in energy technology supply and demand, it would be imprudent to make any estimations beyond that year. Electricity will be available, but as the percentage of hydroelectric power within the system decreases, it will become more expensive, reflecting the increased costs of generated electricity from other sources.

Three cities in the Bay Area receive electricity from the Northern California Power Agency (NCPA): Palo Alto, Santa Clara, and Alameda. They represent some 4 percent of the population of the study area. Palo Alto receives all of its power from the Central Valley Project, a hydroelectric power plant. Half of Santa Clara is also supplied by the Central Valley Project. The rest of Santa Clara's energy needs and all of Alameda's are purchased wholesale through PG&E. NCPA's near-term plans call for adding geothermal power to its energy mix, as well as a small refuse-fired power plant in Alameda that would supply most of Alameda's energy needs. An additional hydroelectric plant is also planned.

All of the electricity for the Bay Area is brought in by PG&E transmission lines including NCPA power.

Natural gas is supplied to the Bay Area by PG&E. Natural gas is brought into San Francisco and the South Bay from the southwest (via El Paso Natural Gas) and distributed from the Milpitas terminal/regulating station.

The Marin-Sonoma, Napa-Solano, and Livermore-Amador Valley areas receive natural gas from Canadian supplies via the Creed station in Solano County. Contra Costa and the East Bay receive Canadian natural gas via the Antioch terminal. The East Bay also receives natural gas from the southwest via the Milpitas terminal.

Future natural gas supplies for California are uncertain. Gas supplies from the southwest have steadily declined since 1970, and will continue to decline if Federal well-head price regulation continues. The Canadian government has advanced a "Canada First" policy, making renewal of Canadian natural gas contracts as they come due in 1985 uncertain. If these trends continue, industrial, commercial, and even residential customers will be curtailed in the 1980s (Reference 35).

To offset decreasing natural gas supplies, California utilities propose the following supplementary supplies: liquefied natural gas from Alaska and Indonesia, synthetic natural gas from coal in the Four Corners area, North Alaska gas, and pipeline deliveries (intrastate, interstate, and foreign sources). The above supplemental supply schemes are not definite. They are technically and financially risky, costly, and capital intensive and require action, changes, and approvals by governmental bodies.

In conclusion, future gas supplies to California from traditional and potential new sources cannot be reliably predicted. Total supplies to California will probably decline significantly through 1980. By 1985, supplies may be marginally above 1975 levels, but the estimate is subject to uncertainties ranging from a low of minus 30 percent to a high of plus 55 percent (Reference 36). Natural gas prices are forecast to double by 1980 and more than triple by 1985 (Reference 36).

## C. POPULATION TRENDS

### 1. Population Distribution

Table 18 shows the total population of the study area in 1975. Santa Clara and Alameda Counties contain 48.2 percent of the area's population. San Francisco, Contra Costa, and San Mateo Counties each contain about an eighth of the total; however, they differ widely in concentration of population. San Francisco is highly urbanized with little potential for population growth, while large portions of Contra Costa and San Mateo are undeveloped. Marin, Solano, Sonoma, and Napa Counties each contain five percent or less of the total population and are comparatively suburban and rural in character.

Table 19 shows the 1976 population rank in California, percentage of Black and Spanish surname minorities, median age, and projections of age distribution.

Alameda and Santa Clara Counties have the highest populations; Napa is the only county in the area with fewer than 100,000 people. Alameda County also has the largest percentage of Blacks, closely followed by San Francisco. Although Santa Clara County has almost the lowest percentage of Blacks in its population, it has the highest percentage of people with Spanish heritage. Sonoma has the lowest percentage of Blacks and the second lowest percentage of individuals of Spanish extraction.

Solano County has the lowest median age (24.8), San Francisco the highest (34.4). San Francisco is the only county that is gradually losing population, most likely to the other counties. The single-family housing shortage is most acute in San Francisco; those who migrate from the city are often families hoping to own a house in the suburbs.

Population growth projections for 1980 indicate that all counties will have fewer residents under the age of 18 (in San Mateo, Santa Clara, and Contra Costa, there may be a 10 percent decrease from the 1970 decade for this age category). All counties are projected to have an increase in the 18-54 age category. Napa, Sonoma, and Santa Clara are the only counties projected to have a decrease in the percentage of population over 54; all other counties are projected to have an increase in that category.

TABLE 18
POPULATION OF STUDY AREA

| Subregion | ABAG[1] | Department of Finance E-O[2] | County |
|---|---|---|---|
| Marin-Sonoma | 256,300 | 265,600 | 262,800[3] |
| Napa-Solano | 209,300 | 264,800 | 216,500[4] |
| Contra Costa | 502,000 | 491,700 | 477,900[5] |
| East Bay | 1,018,300 | 1,098,700 | 1,154,000[6] |
| Livermore-Amador Valley | 107,400 | 107,900 | 104,900[7] |
| South Bay | 1,119,900 | 1,207,600 | 1,239,000[8] |
| San Mateo | 545,200 | 569,700 | 572,000[9] |
| San Francisco | 672,700 | 669,000 | 703,700[10] |
| | 4,431,100 | 4,675,000 | 4,730,100 |

[1] Reference 16

[2] Reference 19

[3] Reference 37

[4] Reference 38

[5] Reference 39

[6] Reference 40

[7] Reference 39, extrapolated by EIP.

[8] Reference 41

[9] Reference 16

[10] Reference 42

TABLE 19
DEMOGRAPHIC CHARACTERISTICS, 1976

| County | % of 9-County Total | Rank in State | % Black | % Spanish Heritage | Median Age | Projection of Age Distribution[1] | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Under 18 | 18-54 | Over 54 |
| Alameda | 22.5 | 5 | 15 | 13 | 28 | - | + | + |
| Contra Costa | 12.1 | 9 | 8 | 9 | 29.8 | - | + | + |
| Marin | 4.5 | 19 | 2.5 | 6 | 29.8 | - | + | + |
| Napa | 1.9 | 29 | 1 | 8 | 32.3 | - | + | - |
| San Francisco | 13.8 | 6 | 14 | 14 | 34.4 | - | + | + |
| San Mateo | 11.9 | 10 | 5 | 11 | 29.5 | - | + | + |
| Santa Clara | 24.3 | 4 | 2 | 18 | 25.7 | - | + | - |
| Solano | 3.9 | 22 | 10 | 11 | 24.8 | - | + | + |
| Sonoma | 5.1 | 18 | 1 | 7 | 29.8 | - | + | - |

Source: References 20, 21 and 22; extrapolations by EIP.

[1] + = increase; - = decrease.

## 2. Population Projections and Growth

In the 1930s, urban development in the Bay Region was concentrated in San Francisco, Alameda, and Contra Costa Counties. Before the Second World War, San Francisco, Alameda, Contra Costa, Marin, and San Mateo counties experienced the region's largest growth in terms of rate and actual numbers. Since 1946, however, San Francisco's population has become relatively constant. Meanwhile, the growth rate in the southern counties of Santa Clara and San Mateo has mushroomed, and the northern counties of Marin, Napa, Solano, and Contra Costa have also shown a large population gain.

Early Bay Region growth was caused almost entirely by people moving into the area. Then as population grew, increases resulting from new births became more important as a growth factor than in-migration.

During the past ten years, the scattered development in the Santa Clara Valley and southern Alameda County has been filled in, the urban area in central Contra Costa has expanded, and there has been a growth of scattered, low-density development throughout central Sonoma County. The remaining regional growth has been accommodated in smaller, scattered areas of new, low-density developments and in increased densities in urban areas. Most high-density residential areas are located adjacent to major employment centers.

Tables 8 and 20 through 27 show the population projections for the study area for the period 1980-2020. The ABAG Series 3 Projections (Reference 14), used as a base for the Environmental Management Plan, project population, housing, employment, and land use in the Bay Region to the year 1990. The California Department of Finance E-O projections (Reference 17) are indicated as required by the State Air Resources Board for the review of Clean Water Grant Projects. Population growth must be compared to these figures in critical air areas. The San Francisco Bay Region is identified as a critical air basin. The ABAG and Department of Finance E-O projections differ in the fertility rate, in-migration rates, and population base. The E-O series assumes a future level of fertility of 2.1 children per female (equivalent to zero population growth); the ABAG series assumes a fertility rate range of 1.8 (high projections) to 1.5 children per woman (low projections). County projections are indicated when available.

In the period 1975 to 1990 (based on the ABAG projections), populations in Napa-Solano and the Livermore-Amador Valley will increase over 40 percent. Contra Costa and Marin-Sonoma populations will increase 32 and 29 percent, respectively. The South Bay will have a population increase of 10 percent, San Mateo and the East Bay subregions less than 3 percent, and San Francisco population will decrease by 5 percent.

Over the long range, 1975-2020 (based on Department of Finance projections), Marin-Sonoma and the Livermore-Amador Valley subregions will experience more than 50 percent growth. Contra Costa will

TABLE 8
PROJECTED POPULATION GROWTH
IN THE STUDY AREA 1975-2020

| Subregion | Type of Projection | | | | | |
|---|---|---|---|---|---|---|
| | ABAG (high) | | | E-0 | | |
| | 1975 (persons) | 1990 (persons) | % change | 1975 (persons) | 1990 (persons) | % change |
| Marin-Sonoma | 256,300 | 330,654 | 29% | 265,600 | 408,520 | 54% |
| Napa-Solano | 209,300 | 297,350 | 42% | 264,800 | 304,300 | 15% |
| Contra Costa | 502,000 | 660,992 | 32% | 491,700 | 718,794 | 46% |
| East Bay | 1,018,300 | 1,050,630 | 3% | 1,098,700 | 1,223,900 | 11% |
| Livermore-Amador Valley | 107,400 | 154,100 | 43% | 107,900 | 168,606 | 56% |
| South Bay | 1,119,900 | 1,240,947 | 11% | 1,207,600 | 1,578,200 | 31% |
| San Mateo | 545,200 | 557,739 | 2% | 569,700 | 599,500 | 5% |
| San Francisco | 672,700 | 641,906 | - 5% | 669,000 | 564,200 | -16% |
| Total | 4,431,100 | 4,934,318 | | 4,675,000 | 5,566,020 | |

Source: References 16 and 19.

TABLE 20
POPULATION PROJECTIONS 1980-2020
MARIN-SONOMA SUBREGION

| Source | Year | | | | |
|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | 2010 | 2020 |
| ABAG (high)[1] | 281,879 | 330,654 | n.a.[4] | n.a. | n.a. |
| (low) | 269,317 | 293,180 | n.a. | n.a. | n.a. |
| Department of Finance E-0[2] | 299,338 | 326,816 | 356,272 | 383,376 | 408,520 |
| County[3] | 300,460 | n.a. | n.a. | n.a. | n.a. |

[1] Reference 5

[2] Reference 19

[3] Reference 37, 43

[4] Not Available.

TABLE 21
POPULATION PROJECTIONS 1980-2020
NAPA-SOLANO SUBREGION

| Source | Year | | | | |
|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | 2010 | 2020 |
| ABAG (high)[1] | 224,326 | 297,350 | n.a.[4] | n.a. | n.a. |
| (low) | 220,657 | 238,217 | n.a. | n.a. | n.a. |
| Department of Finance E-0[2] | 230,048 | 238,491 | 243,100 | 282,500 | 304,300 |
| County[3] | 257,800 | 289,000 | n.a. | n.a. | n.a. |

[1] Reference 16

[2] Reference 19

[3] Reference 38

[4] Not Available.

TABLE 22
POPULATION PROJECTIONS 1980-2020
CONTRA COSTA SUBREGION

| Source | Year | | | | |
|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | 2010 | 2020 |
| ABAG (high)[1] | 544,354 | 660,992 | n.a.[4] | n.a. | n.a. |
| (low) | 534,976 | 591,516 | n.a. | n.a. | n.a. |
| Department of Finance E-0[2] | 524,308 | 584,496 | 635,121 | 677,403 | 718,794 |
| County[3] | 510,122 | 582,471 | n.a. | n.a. | n.a. |

[1] Reference 16

[2] Reference 19

[3] Reference 39

[4] Not Available.

TABLE 23
POPULATION PROJECTIONS 1980-2020
EAST BAY SUBREGION

| Source | Year | | | | |
|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | 2010 | 2020 |
| ABAG (high)[1] | 1,047,942 | 1,050,630 | n.a.[4] | n.a. | n.a. |
| (low) | 1,037,451 | 1,039,574 | n.a. | n.a. | n.a. |
| Department of Finance E-0[2] | 1,121,500 | 1,171,700 | 1,196,100 | 1,209,800 | 1,223,900 |
| County[3] | 1,216,000 | 1,337,000 | 1,481,000 | n.a. | n.a. |

[1]Reference 16

[2]Reference 19

[3]Reference 40

[4]Not Available.

TABLE 24
POPULATION PROJECTIONS 1980-2020
LIVERMORE-AMADOR SUBREGION

| Source | Year | | | | |
|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | 2010 | 2020 |
| ABAG (high)[1] | 120,844 | 154,100 | n.a.[4] | n.a. | n.a. |
| (low) | 118,136 | 149,712 | n.a. | n.a. | n.a. |
| Department of Finance E-0[2] | 115,092 | 137,104 | 148,979 | 158,897 | 168,606 |
| County[3] | 111,978 | 136,610 | n.a. | n.a. | n.a. |

[1] Reference 16

[2] Reference 19

[3] Reference 39

[4] Not Available.

TABLE 25
POPULATION PROJECTIONS 1980-2020
SOUTH BAY SUBREGION

| Source | Year | | | | |
|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | 2010 | 2020 |
| ABAG (high)[1] | 1,180,543 | 1,240,949 | n.a.[4] | n.a. | n.a. |
| (low) | 1,163,805 | 1,228,563 | n.a. | n.a. | n.a. |
| Department of Finance E-0[2] | 1,256,800 | 1,363,800 | 1,462,900 | 1,524,800 | 1,578,200 |
| County[3] | 1,189,400 | 1,254,900 | n.a. | n.a. | n.a. |

[1] Reference 16

[2] Reference 19

[3] Reference 41

[4] Not Available.

TABLE 26
POPULATION PROJECTIONS 1980-2020
SAN MATEO SUBREGION

| Source | Year | | | | |
|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | 2010 | 2020 |
| ABAG (high)[1] | 555,225 | 557,739 | n.a.[4] | n.a. | n.a. |
| (low) | 583,700 | 609,400 | 616,000 | 609,800 | 599,500 |
| Department of Finance E-0[2] | 593,100 | 637,500 | 664,500 | n.a. | n.a. |
| County[3] | | | | | |

[1] Reference 16

[2] Reference 19

[3] Reference 19

[4] Not Available.

TABLE 27
POPULATION PROJECTIONS 1980-2020
SAN FRANCISCO SUBREGION

| Source | Year | | | | |
|---|---|---|---|---|---|
| | 1980 | 1990 | 2000 | 2010 | 2020 |
| ABAG (high)[1] | 667,981 | 641,906 | n.a.[4] | n.a. | n.a. |
| (low) | 664,559 | 645,020 | n.a. | n.a. | n.a. |
| Department of Finance E-0[2] | 651,400 | 621,900 | 599,500 | 580,900 | 564,200 |
| County[3] | 710,050 | 765,572 | n.a. | n.a. | n.a. |

[1] Reference 16

[2] Reference 19

[3] Reference 42

[4] Not Available.

experience the largest increase in persons. The Contra Costa subregion, the Napa-Solano subregion, and the Livermore-Amador Valley will experience rapid growth.

Population is expected to grow in areas where land is available for development; this will fill in undeveloped areas in the central counties of the study area (Alameda, Contra Costa, San Mateo). When land becomes unavailable for development, as in San Francisco, people will move to adjacent areas, and will continue to absorb vacant land near urbanized areas such as in the South Bay subregion.

## D. LAND USE MANAGEMENT

### 1. Present Urban Patterns and Land Use

Land use and special features are delineated in Figure 7. The varied topography of the San Francisco Bay Region's nine counties has played a major role in the area's development. The influence of the mountain ranges on both sides of the Bay is evident in today's land use patterns.

The Bay is almost entirely circled by a continuous band of intensively-developed land. This is land with building structures spaced 50 feet or less apart and includes commercial, residential, and dense industrial uses.

With the exception of parts of the northern shore, the development pattern starts at the Bay's edge and moves inland to the foothills. Industries start the pattern next to the Bay, followed by freeways, businesses, and residential development. The larger inland urban areas have followed a concentric pattern built around a commercial-industrial center with high- and medium-density residential areas.

In terms of the concentration of business areas, employees, and residential densities, the urban cores of the region are the San Francisco-Oakland area and the development around San Jose. Outside of these highly-developed areas are extensively-developed suburbs: the peninsula between San Francisco and San Jose, western Santa Clara County, southern Alameda County, central Contra Costa County, and eastern Marin County.

Santa Rosa is the region's largest independent urban area located beyond the community ranges of the regional core; it has a relatively low-density development. The other large urban center in the region is Walnut Creek-Concord area of Contra Costa County. Twenty years ago it was predominantly rural in character; today an almost unbroken band of urban development extends from Orinda on the west and Martinez on the north to Danville on the south. The bulk of this new growth consists of low-density residential development.

Although the Bay Region's population has increased by nearly a third in the last 20 years, the regional pattern of development has not changed substantially, but rather has enlarged as a result of adding to developed areas.

The general changes in residential land use over the past twenty years have taken place primarily in the west side of the Santa Clara Valley, formerly scattered development; Southern Alameda County and parts of the Livermore Valley; Central Contra Costa County, which has expanded greatly; and Central Sonoma County, an increase of scattered low-density development.

Agriculture continues to be one of the region's largest land users; the basic pattern of cultivated land approximates the pattern of over twenty years ago, but less land is in cultivation. Urban expansion has resulted in large changes throughout the region, notably in Santa Clara, Contra Costa, and Sonoma Counties. The construction of Lake Berryessa in Napa County also reduced agricultural acreage.

The cultivated agricultural areas in the region are the most vulnerable to intrusions of urban development, since both land uses seek the same type of conditions: best soils, level sites, and good climates. Virtually all urban expansion has moved into these types of areas. The noncultivated agriculture land in the region has been disturbed less than the areas under cultivation, primarily because it is hilly or gently rolling. These lands are used for grazing and are not easily developed for urban uses.

Open space has been developed for extensive industrial uses, such as the solar extraction of salt in the ponds surrounding the Bay in San Mateo, Santa Clara, and Alameda Counties of the South Bay, and in Napa and Solano Counties of the North Bay. Other open-space industrial uses include the natural gas fields in Rio Vista, the gravel pits in Pleasanton, and the bunkers of Hercules.

The least extensive open-space use has been for recreation. Parks, land, and water for recreation are randomly distributed throughout the region. Marin County has the largest amount of land set aside for recreation, including the Point Reyes National Seashore, the Marin Municipal Water District, and various areas under State control such as Angel Island (which may be transferred to the Golden Gate National Recreation Area). Other major recreational parks are those in the East Bay along the tops of the Berkeley-Oakland hills.

Table 9 lists the State, county, and regional parks and military installations shown in Figure 7.

The region's major employment centers are located along the Bay plain, the northern edge of Contra Costa County Carquinez Straight, Suisun Bay, and the San Joaquin River. The bulk of new employment growth in the last 20 years has taken place in these same areas. The general pattern of industrial growth has been a

TABLE 9

STATE, COUNTY, AND REGIONAL PARKS AND MILITARY INSTALLATIONS SHOWN IN FIGURE 7, LAND USE AND SPECIAL FEATURES

STATE PARKS

| | | |
|---|---|---|
| Ps | 1 | Bothe-Napa Valley State Park |
| | 2 | Sugar Loaf Ridge State Park |
| | 3 | Jack London State Historic Park |
| | 4 | Tomales Bay State Park |
| | 5 | Samuel P. Taylor State Park |
| | 6 | Stinson Beach State Beach |
| | 7 | Mt. Tamalpais State Park |
| | 8 | Thornton State Beach |
| | 9 | San Gregorio) |
| | | Pomponio ) State Beaches |
| | | Pescadero ) |
| | 10 | Butano State Park |
| | 11 | Mt. Diablo State Park |
| | 12 | Henry W. Coe State Park |
| | 13 | Frank's Tract State Recreation Area |
| | 14 | Benicia State Recreation Area |
| | 15 | Portola State Park |
| | 16 | Angel Island State Park |

REGIONAL PARKS (Contra Costa and Alameda Counties)
(L.B.) indicates that there are no facilities.

| | | |
|---|---|---|
| Pr | 1 | J.F. Kennedy Grove Regional Park |
| | 2 | Tilden and Wildcat Canyon Regional Parks |
| | 3 | Point Pinole Regional Shoreline |
| | 4 | George Miller, Jr., Regional Park |
| | 5 | Brooks Island and Point Isabel Regional Park |
| | 6 | Briones Regional Park |
| | 7 | Martinez Waterfront Regional Park |
| | 8 | Shadow Cliffs Regional Recreation Area |
| | 9 | Black Diamond Mines Regional Preserve |
| | 10 | Contra Loma Regional Park |
| | 11 | Morgan Territory Regional Park (L.B.) |
| | 12 | Diablo Foothills Regional Park (L.B.) |
| | 13 | Las Trampas Regional Wilderness |
| | 14 | Chabot and Redwood Regional Parks |
| | 15 | Cull Canyon Regional Park |
| | 16 | Don Castro Regional Park |
| | 17 | San Leandro Bay |
| | 18 | Garin Regional Park |
| | 19 | Coyote Hills Regional Park |
| | 20 | Del Valle Regional Park |
| | 21 | Ridgelands Regional Park (L.B.) |

TABLE 9
(Continued)

| | | | |
|---|---|---|---|
| REGIONAL PARKS (Continued) | | | |
| | | 22 | Sunol Regional Park Wilderness |
| | | 23 | Mission Peak Regional Park (L.B.) |
| | | 24 | Alameda Creek Quarries (L.B.) |
| | | 25 | Camp Ohlone |
| COUNTY PARKS | | | |
| Sonoma | Pc | 1 | Mt. Hood County Park |
| | | 2 | Lake Hennessey Recreation Area |
| Napa | | 3 | Rector Reservoir Recreation Area |
| | | 4 | Milliken Reservoir Recreation Area |
| | | 5 | Lake Curry Recreation Area |
| Solano | | 6 | Blue Rock Springs County Park |
| Marin | | 7 | Deer Park County Park |
| San Mateo | | 8 | Coyote Point County Park |
| | | 9 | Woodart County Park |
| | | 10 | McDonald County Park |
| | | 11 | San Mateo County Memorial Park |
| | | 12 | Pescadero Creek County Park |
| Santa Clara | | 13 | Foothill Park |
| | | 14 | Upper Stevens Creek County Park |
| | | 15 | Stevens Creek County Park |
| | | 16 | Sanborn Canyon County Park |
| | | 17 | Sunnyvale Mountain Park |
| | | 18 | Villa Montalvo Arboretum |
| | | 19 | Santa Teresa County Park |
| | | 20 | Uvas Canyon County Park |
| | | 21 | Coyote River Park South |
| | | 22 | Anderson Lake County Park |
| | | 23 | Alum Rock Park |
| | | 24 | Ed Levin County Park |
| | | 25 | Coyote River County Parkway |
| | | 26 | Mt. Madonna County Park |

TABLE 9
(Continued)

| | |
|---|---|
| MILITARY RESERVATIONS | |
| M1 | U.S. Naval Reservation near Binghamton in Solano County |
| M2 | U.S. Military Reservation 4 miles north of Travis A.F. Base |
| M3 | Travis Air Force Base |
| M4 | Concord Naval Weapons Station |
| M5 | U.S. Military Reservation at Rio Vista |
| M6 | Mare Island Naval Shipyard |
| M7 | U.S. Naval Resevvation 8 miles northwest of Mare Island |
| M8 | Hamilton Field A.F. Base (has been declared surplus) |
| M9 | Naval Fueling Station, near Pt. San Pablo, Richmond |
| M10 | Pt. Reyes Coast Guard Station |
| M11 | U.S. Army Transport Facility, Oakland |
| M12 | U.S. Naval Supply Center, Oakland |
| M13 | U.S. Naval Reservation, Treasure Island |
| M14 | U.S. Coast Guard Reservation, Yerba Buena Island |
| M15 | U.S. Naval Air Station, Alameda |
| M16 | Fort Funston, San Francisco |
| M17 | U.S. Military Reservation, Pillar Point |
| M18 | U.S. Naval Air Station, Moffett Field |

concentrated expansion of existing areas. All of the region's employment centers are located on relatively flat land close to one or more major transportation facilities: highways, railroads, seaports, and airports. Most of the centers can be regarded as permanent land use.

Zoning has been adopted by most cities and counties in the Bay Region. In the last fifteen years, specialized land uses and special land use regulations have been developed to fit the potentials and objectives for growth in each community.

The general zoning pattern of the region is closely related to existing land use with two exceptions. First, in Santa Clara, Marin, Sonoma, and Napa Counties, agricultural districts permit residential development or parcels of less than five acres. Second, land zoned for industry in the region far exceeds present and probable future development needs, especially along the Bay from Hayward through Richmond to Antioch.

Most of the region is zoned for either residential, commercial/industrial, or open space. Only Sonoma County still has a large part of its territory unclassified or unzoned.

## 2. Land Use Trends

In 1975, local jurisdictions throughout the Bay Region set aside some 423,000 acres in developable reserves, an amount equivalent to the land currently urbanized in the region. Estimates are that by 1990 this developable land reserve will be drastically depleted (Reference 16).

Table 10 summarizes land in use and in reserve in the San Francisco Bay Region in 1975. Table 11 presents ABAG's Provisional Series 3 Projections for urbanized and vacant land in 1975 projected to 1990 (Reference 16). The industrial category makes up a larger portion of the total reserve (18%) than of existing development (15%), and constitutes a larger amount of land than is now in industrial use. Region-wide industrial land reserves are more than adequate through 1990. Projected consumption of industrial land is highly concentrated in the South Bay.

Regional residential/commercial developable reserve is substantial (345,000 acres) and almost as large as the existing developed land use (380,000 acres). The capacity of this land to accommodate new growth is curtailed by two factors: zoning densities are low, and more than half of the residential reserve has environmental hazards and urban services problems. Almost half of the reserve is located in the South Bay counties of Alameda, Santa Clara, and San Mateo. The North Bay counties of Marin, Sonoma, Napa, and Solano account for about a third of the reserve. According to ABAG, the residential/commercial land reserve will be inadequate to accommodate the high regional growth projected, with virtually the entire reserve consumed by 1990. Although some of the industrial reserve will be

unused, residential development is not expected to take place in the lands reserved for industrial use.

Of the 4,500,000 total acres in the region, some 3,600,000 acres are classified as deferred or excluded lands. This acreage includes designated open space, public lands, agricultural preserves, areas zoned for 20 or more acres per dwelling unit, inaccessible land or land on steep slopes or with flood problems and the like, and areas where improvements are limited to septic tanks and wells. Land uses allowable on deferred or excluded lands would include very limited residential development, forestry, grazing, and agricultural activities. ABAG's projections assume that excluded lands are not developable and that land uses similar to existing ones will continue.

Little information is available on agricultural land uses and trends in the Bay Area. ABAG projects that employment in agriculture will decline, but to a lesser extent with lower population growth. Future agricultural land uses are not projected. To the extent that existing agricultural lands are allowed to be converted to other uses by zoning practices and public services extensions, conversion will take place, assuming that there is sufficient economic incentive to do so. Generally, agricultural lands suitable for industrial, commercial, and residential development are converted because they are worth more as developable land than they can generate in agricultural revenues. In areas where enough developable land is available, agricultural land use can continue unabated. This is the case in Napa and Sonoma Counties.

The projections for urbanized and vacant lands (Table 11) show little difference, region-wide, between the high and low cases, whereas there is substantial difference in the projected residential and commercial vacant lands.

## E. WATER QUALITY MANAGEMENT

### 1. Water Quality Problems

Currently, the most serious problems occur in the following surface-water resources:

South San Francisco Bay;
Napa, Petaluma, and Sonoma River estuaries;
Near-shore Pacific Ocean Waters (During periods of wet-weather combined sewer bypass of treatment plants);
Suisun Bay.

The nature of the degradation varies. Typical problems include low levels of dissolved oxygen, excessive coliform bacteria, excessive algal growth, and the presence of toxins in bottom sediments.

Forecasting potential future problems is difficult, although important in regional planning schemes. Basically, the future quality of surface water resources will be affected by the level of continued pollutant input and any changes in the hydrologic characteristics of a particular water resource. The Bay itself is primarily subject to this latter factor as continued demands are placed on the fresh water flowing from the Delta. This results in a lowered capacity to dilute and disperse pollutants.

Pollutant input results from "point" (discrete discharges of municipal or industrial wastewater) and "nonpoint" (diffuse sources, including urban and wildland runoff, agricultural wastewater, etc.) sources. The balance between increasingly stringent waste treatment standards and the expanding volume of waste products will most directly affect future water quality. As secondary sewage-treatment facilities (required by the Federal Water Pollution Control Act Amendments of 1972) are installed, the biological quality of receiving waters should improve. On the other hand, the continuing input of nitrogen, phosphorus, and heavy metals to surface waters will probably result in an increase of algal growth and toxins in bottom sediments of the Bay.

Implementation of the current San Francisco Wastewater Management Plan should effectively eliminate the current problem of direct discharge of untreated sewage to the near-shore areas of the Pacific Ocean during rainstorms.

Current water quality problems associated with ground water in the study area's ground-water basins are due primarily to overdraft and saline water intrusion. Both problems are being corrected through recharge of the basins and building of saline water intrusion barriers along the South Bay in Santa Clara Valley, the area of major concern.

Two ground-water systems, the Niles cone in southwestern Alameda County and the upstream ground-water basins of the Livermore-Amador Valley, both in the Alameda Creek watershed, have potential water quality problems caused by the waste load imposed during the dry months of the year by municipal sewage treatment operations. The deeper aquifers are left relatively undisturbed; the upper aquifers in the Livermore-Amador-San Ramon Valleys have high mineral and nitrate content near waste disposal sites.

## 2. Water Quality Management in the San Francisco Bay Region

The State Water Resources Control Board (SWRCB) is responsible for controlling water quality management throughout California. In particular, the SWRCB determines beneficial uses and establishes water quality standards and criteria to be met. Regional boards are responsible for the implementation of these regulations and criteria. The San Francisco Regional Water Quality Control Board (RWQCB) prepared a water quality management plan for the Bay Area, which was adopted in 1975 (Reference 1). This plan contains a

description of beneficial uses of water resources within the San Francisco Basin, including potential beneficial uses that are not present uses but may become established in the future, and sets ambient pollutant levels for surface and ground-water resources based on the specified beneficial uses.

In addition to a discussion of water resources, the plan contains an examination of pollution sources including wastewater treatment plants. It defines the need for future water pollution control facilities and suggests various consolidation and expansion strategies for existing treatment facilities.

Of particular importance to sludge disposal is the role of the RWQCB in regulating landfill disposal sites from a water quality standpoint. The SWRCB has published guidelines establishing criteria on landfill site design and a site rating system that determines the type of wastes that a landfill may receive (Reference 2). These guidelines also establish requirements on the moisture content of any sludge to be disposed of in a landfill.

The regulatory authority of the SWRCB and RWQCB would also apply to any existing or proposed programs utilizing wastewater solids on agricultural lands, insofar as such a program might affect surface- or ground-water quality.

In theory, the SWRCB should provide a centralized, coordinated program for water quality in the San Francisco Bay Basin. In practice, however, actions taken by other Federal, State, and local agencies that affect water quality are often uncoordinated with SWRCB actions (Reference 7). Examples of such independent actions include land use decisions, dredging, development, filling, and channel maintenance within San Francisco Bay, flood-control activities, soil conservation practices, and scheduling flows of Federal and State reservoir systems on the Sacramento River. In addition, the Environmental Protection Agency (EPA) and Army Corps of Engineers issue permits and regulations independently of the SWRCB. For example, EPA regulates all sea disposal of wastes and currently prohibits ocean disposal of sewage sludge.

## F. AIR QUALITY MANAGEMENT

### 1. Wind Data

The Bay Area is normally exposed to a westerly flow of marine air from the Pacific that moves in response to low pressures in the San Joaquin-Sacramento Valley caused by heating. The only sea-level gap in the coastal mountains is the Golden Gate, through which a strong flow of air passes in spring and summer. The flow then normally splits, going south toward the South Bay and north through Carquinez Strait. Secondary flows over the coastal mountains pass through the San Bruno gap, south of San Francisco, and the Crystal Springs gap in San Mateo County. Lesser wind gaps in the East Bay hills affect the Livermore and Amador Valleys.

Wind patterns in the South Bay are heavily influenced by the terrain, resulting in a prevailing flow roughly parallel to the Santa Clara Valley's northwest-southeast axis. Wind speeds are highest in spring and summer and lowest in fall and winter. Night and early morning hours have light winds and are frequently calm in all seasons; summer afternoons and evenings are quite breezy. Strong winds are rare, accompanying an occasional winter storm.

The Marin-Sonoma area is fairly sheltered from sea breezes by the Coast Range. Winds blow on a predominantly northwest-southeast axis in the southern part of the region. The northern portion is less sheltered from the sea breeze and frequently exhibits westerly winds. At night, downslope valley flows dominate. Calm and light winds occur more than 55 percent of the time at Santa Rosa. Because of frequent light winds, the pollution potential of the Marin-Sonoma area is moderately high to high. Despite a high potential for pollution, pollutant levels are low compared to most of the Bay Area, due to the lack of industry and the low level of development (Reference 7).

The inland Livermore-Amador Valley has a high frequency of calm. Predominant wind directions reflect the location of the Hayward Gap to the west and the Niles Canyon to the southwest.

Most of the Contra Costa areas are exposed to strong flow through the Golden Gate and Carquinez Strait. The northern Diablo Valley, however, is somewhat sheltered and has lighter winds oriented in a north-south direction.

Winds in the Napa-Solano area reflect the gross terrain. Winds at Napa are southerly. The range of hills separating Napa and Solano Counties causes winds near Fairfield to be primarily southwesterly, reflecting the position of Carquinez Strait. Wind speeds are generally higher in Fairfield than in Napa.

Wind conditions vary across the East Bay. At the north, near Oakland, winds are strong and from the west, reflecting the area's exposure to winds from the Golden Gate. Further south, winds decelerate and become northwesterly. The Fremont-Newark area has frequent light winds.

The wind regime in the San Mateo subregion strongly reflects the proximity of mountain gaps such as the San Bruno and Crystal Springs gaps. The frequency of winds from west through northwesterly directions exceeds the frequency from all other directions combined. A slight secondary maximum from the southeast reflects the influence of winter storms. Wind speeds are relatively high compared to other areas of the Bay, especially in the westerly directions.

## 2. Present Emissions

Air quality standards set limits on the amount of various types of air pollution that should be tolerated in the air people breathe. Medical evidence indicates that if these levels are met, eye and throat irritation and more serious health effects will not appear, even in the most sensitive.

California began setting air quality standards in 1969 under the provisions of the Mulford-Carrell Act. With the passage of the Clean Air Act amendments in 1970, the Federal government began adopting such standards for the entire country. Federal air quality standards are divided into two categories: primary standards designed to protect human health, and more stringent secondary standards to protect property and aesthetics. Wherever there is some variation between State and Federal air quality standards the stricter one applies. State and Federal air quality standards are shown in Table 12.

Ambient air quality is measured at 28 locations within the study area. Major current pollutant problems are oxidant, carbon monoxide, and particulates. Table 13 and Figures 3a-c summarize exceedances of the standards for these pollutants throughout the Bay Area.

Oxidant, also known as photochemical smog, results from a complicated reaction between nitrogen dioxide and organic compounds under the influence of the ultraviolet rays of sunshine. Production of oxidant smog is promoted on warm, sunny days when ventilation is low.

In 1975, the oxidant standard was exceeded at all monitoring sites except the two in San Francisco. Monitoring sites directly affected by wind through the Golden Gate generally exceeded the standards a few days. South of San Francisco, the number of exceedances increased rapidly to a maximum of 49 days at the Alum Rock station in San Jose (see Figure 3a). Exceedances also increased east from San Francisco, reaching a secondary maximum at Livermore, which is affected by both pollutants carried over the East Bay hills and emissions generated locally.

Suspended particulates are liquid or solid particles suspended in the air. Much of this particulate matter is of natural origin, but in industrialized areas, man-made varieties are far more prevalant. Photochemical reactions also produce particulates.

The State standard for 24 hours was exceeded at 15 of the 18 sites where it was monitored in 1975 (it should be noted that particulates are measured only every sixth day). The pattern of particulates exceedances is similar to that of oxidant exceedance, with frequency increasing south and east from San Francisco.

The annual geometric means of total suspended particulate (TSP) show a pattern of low values near the coast, increasing with distance inland, particularly into dry, sheltered valleys. The values shown in Figure 3c are given in micrograms per cubic meter (ug/$m^3$), which is a measure of weight. The Federal primary standard, is 60 ug/$m^3$. In 1975 the Santa Clara and Livermore Valley areas exceeded the State standard, and the Livermore valley exceeded the Federal standard as well.

Sulfur dioxide is a toxic gas formed when sulfur-containing fuel is burned. This substance often oxidizes to form sulfur trioxide, which combines with moisture in the air to form sulfuric acid mist. Both sulfur dioxide and sulfur trioxide can damage vegetation and affect the health of humans and animals.

Sulfur oxides are a problem in the Bay Area near the large oil refineries and chemical plants concentrated in Contra Costa County. Therefore, the monitoring network of 11 sites ranges from Santa Rosa, and Richmond on the west to Pittsburg and Napa on the east. The standards were exceeded in 1975 only at Crockett and Point Richmond, both of which are close to major sources.

Sulfur dioxide is expected to become a greater problem in future years. As supplies of clean-burning natural gas increases, more and more industries and power-generating plants will switch to sulfur containing fuel. Annual average emissions of sulfur dioxide are anticipated to increase from about 260 tons per day in 1975 to about 450 tons per day in 1985 (Reference 30). The number of exceedances of the standards, and the areas affected, can be expected to increase as well.

Carbon monoxide (CO) is a clear, odorless gas; in high concentrations it can cause dizziness, unconsciousness, and even death. The major source of carbon monoxide is the automobile. High concentrations of carbon monoxide are mainly a local problem, occuring near areas of heavy auto traffic when ventilation is poor.

The 8-hour average carbon monoxide standard was exceeded at seven of the 16 monitoring sites where it was measured. Rather than exhibiting a regional pattern, these exceedances are related to the density of traffic surrounding monitoring sites (see Figure 3b). The standard was most frequently exceeded at San Jose, where violations occurred on 23 days. It was exceeded a few times at locations along the San Francisco peninsula, and at the population centers of Oakland and San Francisco.

## 3. Air Quality Problems

The San Francisco Bay Area Air Basin has been designated as an Air Quality Maintenance Area by the California Air Resources Board. This requires the development of long-term air quality strategy to attain and maintain the National Ambient Air Quality Maintenance

Plan between 1977 and 1985. The development of this Air Quality Maintenance Plan began in 1976 and will take two years. The Plan will probably contain land use, transportation, and other control measures.

The Bay Area contains a multitude of air pollutant sources. Automobile exhaust is the greatest single source. Nonvehicular sources such as refineries, manufacturing plants, and generating plants are concentrated in the industrial areas of San Francisco, Oakland, Emeryville, and Northern Contra Costa County.

The geographical distribution of pollutant sources and prevailing winds result in characteristic pattern of pollution exposure. Coastal areas, swept by sea breezes and unaffected by upwind sources, have the best air quality in the Bay Area. As this air moves over urbanized areas, more and more pollutants are added. This results in a general impairment of air quality moving south and east from San Francisco. North of San Francisco the extent of urbanized areas is smaller and air quality is better, although there are many point sources of pollutants in Contra Costa County.

This pattern does not hold true for inert (non-active) pollutants such as carbon monoxide. High concentrations of this pollutant are associated with stagnant air; thus the pattern of exposure is related to traffic levels and is more or less independent of regional location.

Odors are associated with specific sources rather than regional wind patterns. The primary sources of odor complaints in the Bay Area are refineries, most of which are located in north Contra Costa County. Sewage treatment facilities are also a major source of odor associated with light winds (Reference 25).

The pollution potential of the South Bay is high during the entire year. By virture of its location downwind of the major urban centers, this area is a receptor for Bay Area pollutants. The background level is therefore already high, aside from any local contribution. Dilution of pollutants emitted in the Santa Clara Valley is restricted laterally by terrain boundaries and vertically by frequent inversions. Generally, light winds and frequent recircualtion of pollutants by evening drainage flows increase the pollution potential.

There are few major sources of problem odors in the South Bay. Complaints were often received near the now-abandoned Milpitas Sewage Treatment Plant (Reference 25).

San Francisco's air quality is among the best in the region. The city is almost constantly subjected to a steady flow of air from the west that carries pollutants to other parts of the Bay Area.

Also, San Francisco is generally upwind of major sources and urban areas. Despite these advantages, there are periods, most often in fall and winter, when the air becomes stagnant. At these times the entire Bay Area is affected by high pollutant concentrations. Odor complaints in San Francisco are associated mainly with specific manufacturing processes. Some complaints of sewer odors are received, normally in the old sections of the sewer system, where subsidence has cause sewage to pool (Reference 26).

There are few major odor problems in the Marin-Sonoma area due to the lack of industry. Complaints have been received in the past from the vicinity of San Rafael sewage treatment plant (Reference 27).

The pollution potential of the Livermore-Amador Valley is very high. The surrounding elevated terrain, in conjunction with temperature inversions, frequently makes a closed box of the valleys. in which pollutants may quickly reach high levels during periods of low wind speed. Abundant sunshine and warm tmeperatures in summer are ideal conditions for the formation of photochemical oxidant, and the valleys are a frequent scene of photochemical pollution even in the absence of local sources, due to sea-breeze transport of contaminants from westward urban areas (Reference 7).

In the Contra Costa subregion, air pollution potential is low along the Carquinez Strait and San Pablo Bay but high in the inland valleys. Exposure to winds results in relatively low concentrations of pollutants (Reference 7). Odor complaints have been generated by the Central Contra Costa Sanitary District sewage treatment facility in Concord. The now-abandoned sludge digesters and lagoons appear to have been the major problems (Reference 28).

The air pollution potential for San Mateo is generally lower than at most Bay Area sites, since the moderate wind speeds result in considerable horizontal dilution of pollutants. The marine inversion is persistent in the area, however, and high pollutant levels can be realized whenever winds die down, especially in the southern part of the region (Reference 7). Odor complaints have been received about the sewage treatment plants located in Redwood City and Pacifica (Reference 29).

## 4. Expected Air Quality Trends

Federal, State, and local air pollution policies and control strategies have resulted in considerable improvement in air quality in the Bay Area since regulation of pollution emissions began in 1955. Air quality control programs are administered by the State Air Resources Board (ARB), the Bay Area Air Pollution Control District (BAAPCD), and the U.S. Environmental Protection Agency.

The ARB is responsible for enforcing controls on vehicles. The jurisdiction of the BAAPCD is largely limited to nonvehicular sources, primarily industry and burning. The District issues permits for new sources and has established emissions limitations for various pollutants and odorous substances. The BAAPCD is also responsible for the investigation of odor complaints.

The U.S. Environmental Protection Agency has promulgated New Source Performance Standards for sewage treatment plants, adopted by the Bay Area Air Pollution Control District in Regulation 7, Rule 13. The rule sets forth maximum particulate emissions (based on sludge input) and limits the opacity of emissions.

The Air Quality Maintenance Plan is a long range strategy for the attainment and maintenance of the air quality standards. The development of the Plan is being overseen by the Association of Bay Area Governments in cooperation with the BAAPCD and the Metropolitan Transportation Commission.

Carbon monoxide levels have been decreasing since about 1965 as controls on stationary sources and automobiles have become more stringent. Similarly, emissions of sulfur dioxide and hydrocarbons have decreased. Sulfur dioxide ambient concentrations currently do not exceed State and Federal standards. Despite decreased hydrocarbon emissions, oxidant levels still exceed Federal standards many times per year. Regional emissions of particulates have also decreased dramatically due to controls on open burning and stationary sources, but ambient levels still exceed State and Federal standards in many areas (Reference 44).

Predictions of future air quality are not currently available, but predictions of future emission loadings are available (Reference 30). This emission inventory is currently being updated and will be used as input for forecasts of future air quality to be made as part of the Air Quality Maintenance Program.

Of particular importance to the development of sewage sludge disposal alternatives are future trends in particualte emissions. Particulate emissions are expected to increase steadily through 2000, although they will remain well below emissions prior to initiation of controls. This increase is linked to increases in sulfur dioxide emissions, which result in the formation of sulfate particulates. Sulfur dioxide emission increases are a result of anticipated use of sulfur-containing fuel oil to replace natural gas, which will be in short supply in the future.

Particulate concentrations will continue to exceed the ambient air quality standards in the future under current assumptions of fuel supply and demand and population growth. New particualte controls

strategies may be implemented, however, that would alter the present trend. Also important to the development of sewage sludge alternatives are the future trends of nitrogen dioxide emissions. Total emissions of oxides of nitrogen (which includes nitrogen dioxide and nitric oxide, which is converted to nitrogen dioxide in the atmosphere) have been declining recently due to controls on autos. As future energy use increases, this trend will be reversed and total emissions will increase beyond current levels.

## G. SOLID WASTE MANAGEMENT

### 1. State Mandate

Recognizing a need to address solid waste management concerns, the State legislature passed the California Solid Waste Management and Resource Recovery Act of 1972. This legislation established the State Solid Waste Management Board (SWMB) and gave the responsibility for preparing individual solid waste management plans to California's counties. Each plan must be approved by a majority of cities in that county, representing a majority of the population in the incorporated areas. The plans must then be approved by the SWMD. Thereafter, solid waste management activities at the local level must be consistent with the approved plans. By May 1977, five of the nine county plans for the Bay Area (San Francisco, Napa, San Mateo, Contra Costa, Santa Clara) were fully or conditionally approved by the SWMB (Reference 31).

### 2. Relation of County Plans to ABAG EMP Solid Waste Management Program

ABAG's Environmental Management Plan (EMP) is being prepared under the Water Pollution Control Act Amendments of 1972, which require the preparation of area-wide water quality management plans in urban/industrial areas. The Plan is being prepared by ABAG in cooperation with local, regional, State, and Federal agencies. It will include seven management components: surface runoff, air quality maintenance, municipal wastewater facilities, non-point sources of water pollution, industrial discharges, water conservation, reuse, and supply, and solid waste (including municipal wastes, hazardous wastes, and wastewater residuals).

The approach for EMP solid waste management planning is to build on work in progress or completed by other agencies. The work program emphasizes two planning objectives: the first is to develop a plan for the period to 1980 consisting primarily of programs for early implementation that begin to address impairment of air and water quality, public health and safety effects, aesthetic and nuisance effects, ecological effects, and resource depletion effects of land, energy and reusable materials, and waste. The second planning objective is to develop a continuing planning process.

The county solid waste management plans will serve as a basis for ABAG's planning to achieve these objectives. The plans contain descriptions of the current solid waste management practices and facilities for each county in the Bay Area. For the short, medium, and long term, options for future systems are considered and recommended. The planning documents themselves are extensive and contain considerable information on solid waste practices in general and on conditions unique to each county.

### 3. Regional Overview of County Solid Waste Management Plans

a. Existing Systems. Many cities and counties have local ordinances regulating the storage of solid waste; however, the ordinances in general do not include all the minimum standards as adopted by the SWMB in December, 1974. Most residential wastes are collected by private franchised collectors. Franchises are issued by cities and counties and sometimes by special districts. Only three cities in the Bay Area operate their own collection services (Berkeley, San Leandro, and Dixon). In many cases, collection of residential waste is required by local ordinance.

Wastes are usually taken by the collection trucks directly to landfill sites for disposal. In some cases, because of the long distance between collection points and disposal sites, transfer facilities are needed in order to reduce transportation costs. At transfer stations, collected wastes are transferred to much larger long-haul trucks for transportation to a disposal site. In 1975 there were about five such transfer stations in the Bay Area. The largest is located in San Francisco. It is also the only transfer station that included mechanical waste processing such as shredding and recovery of metal cans in 1975.

There were about 60 active landfill sites in the Bay Area in 1975, including three Class I sites for hazardous waste disposal. Many of these sites will be closed by 1980.

In general, cities, counties, and special districts are responsible for solid waste management. The cities and counties have authority for collection, processing, and disposal of wastes within their jurisdictions. Collection of wastes by the franchised collectors is regulated by the city councils or the county boards of supervisors.

Many city and county agencies are involved with various aspects of solid waste management. Typically, the city and county health departments inspect waste disposal activities and enforce waste handling standards. The County Planning Department or Public Works Department is responsible for county-wide solid waste management planning and reviews permit applications for new solid waste facilities.

In addition, depending on location and type of facility, permits for new or expanded solid waste facilities may be required from the San Francisco Regional Air Quality Control Board, Bay Area Air

Pollution Control District, San Francisco Bay Conservation and Development Commission, California Coastal Zone Conservation Commission, State Lands Commission, and U.S. Army Corps of Engineers.

Collection services provided by private companies are paid through user fees. Landfill revenues come from disposal fees charged to commercial haulers and private citizens. In general, collection accounts for 80 to 90 percent of system costs because it is so labor intensive. Disposal operations account for 10 to 20 percent of total costs.

The many public agencies involved in solid waste management incur costs related to administration, planning, regulation, enforcement, and operation of activities. These costs are spread among the involved agencies and are partially financed through public funds and franchise fees.

b. Future Systems -- 1980. Attempts will be made by the cities and counties to make storage and collection standards more uniform. State standards will be the minimum for any adopted county standards. These will include collection service available in all service areas, minimums for frequency of collection, locations, and specifications for containers.

c. Regional Issues in County Plans. An important aspect of the county plans for EMP solid waste planning is the identification of regional solid waste issues. The regional planning issues as identified by the local plans are: development of dependable markets for recovered materials; evaluation of large-scale resource recovery systems; assurance of hazardous waste disposal capacity; and wastewater solids management planning for the increased volume resulting from required air emissions in wastewater treatment facilities. These issues have implications beyond any one county; solutions to these regional problems may require an area-wide approach. The large-scale resource recovery facilities necessary for economic feasibility may require wastes from several jurisdictions. Solutions may involve special or expensive facilities that would be costly for any one county to finance. They may require coordination of physical systems or administrative responsibilities involving two or more agencies.

## 4. Bay Area Solid Waste Management Project

The Bay Area Solid Waste Management Project (BAYSWAMP) involves the development of a comprehensive solid waste management program for the San Francisco Bay Area. The intent of the study is to evaluate all reasonable approaches and to recommend actions or projects that will provide local, State, and Federal officials

with knowledge and recommendations for decision making to establish a solid waste management program. The objectives of the study are to establish sets of priorities for managing the Bay Area's solid wastes. Phase I of the study has been completed. The report concludes that solid wastes must be managed according to the State's minimum standards and that low standards must be properly enforced. Alternatives will be evaluated in detail over the next two years.

## H. TRANSPORTATION

Regional trunk lines carry most travel through defined transportation corridors within the region. They include most of the completed freeways, all of the transbay and strait bridges, the major rail transit lines, and the ferry system.

The highway trunk lines include the major interregional connecting links: U.S. 101 to the north through Sonoma County and to the south through Santa Clara County, Interstate Routes 505 and 80 through Solano County to the north and east, Interstate 580 east and south through Alameda County, Route 17 south from San Jose, and the route around the urban area formed by Interstate 680 and Route 21 between San Jose and Cordelia. In the urban area, the trunk lines include Routes 101 and 280 between San Jose and San Francisco, Route 17 from San Jose through Oakland to Richmond, Interstate 580 between Castro Valley and the Bay Bridge, and a number of other heavily-traveled interconnecting links such as Routes 24, 92, and 85 (see Figure 8).

The regional system includes an extensive support system of roads, streets, and distributive mass transit facilities that connect the local transportation systems in each corridor to the regional trunk lines. Roads include the other routes in the state highway system, ranging from important rural highways such as Routes 1, 12, 37, and 29 in the North Bay to major city streets such as El Camino Real on the Peninsula, 19th Avenue/Park Presidio Boulevard in San Francisco, and San Pablo Avenue, East 14th Street, and Mission Boulevard in the East Bay. Major county highways and city arterials throughout the region are also important to the support system.

A number of terminals in the region function as major transfer points within the regional transportation system in the movement of either persons or goods. Six major port facilities are located in the San Francisco Bay Region: Encinal Terminals (Alameda) and the Ports of Benicia, Oakland, Redwood City, Richmond, and San Francisco. Most waterborne cargo is handled by private concerns.

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## Geographic Reference

Study Area Boundary

Figure No. 1

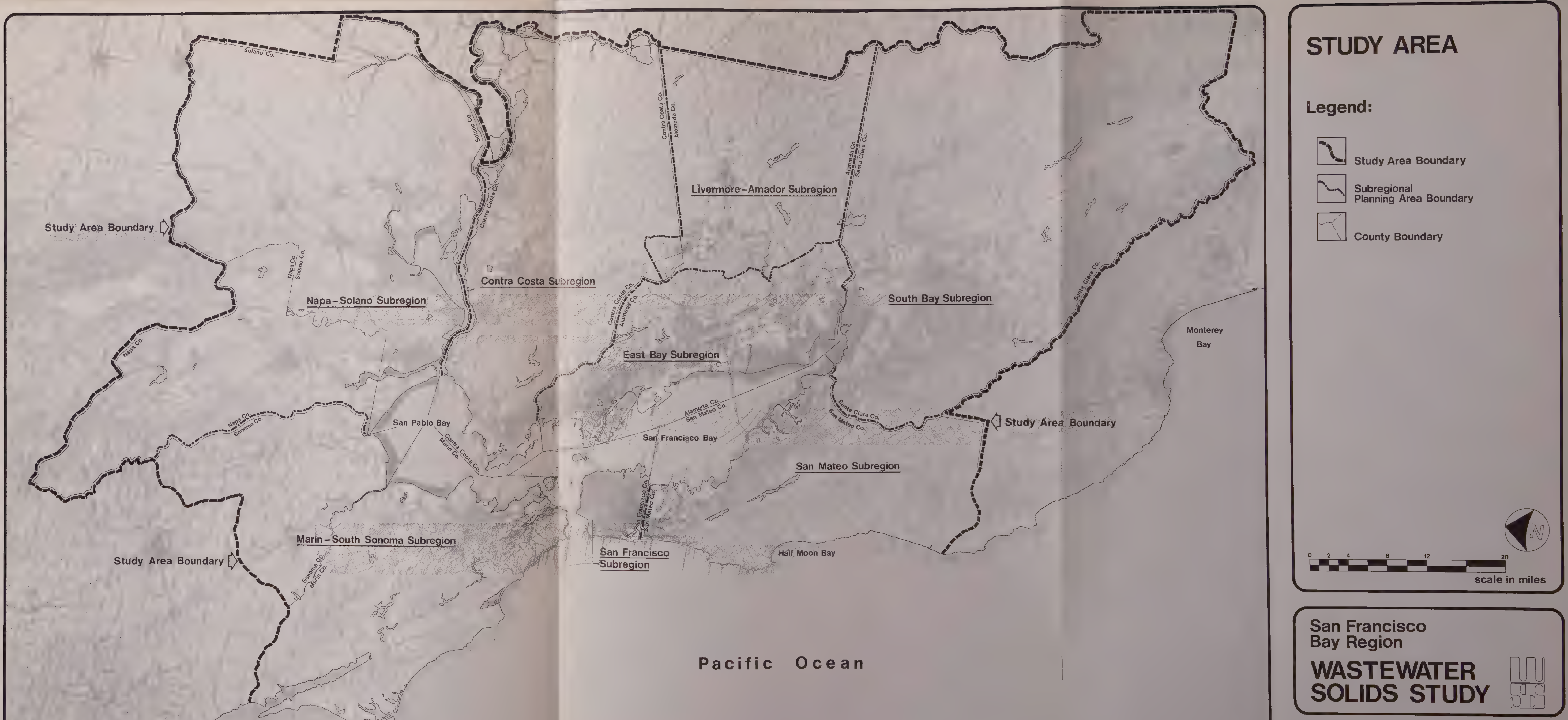
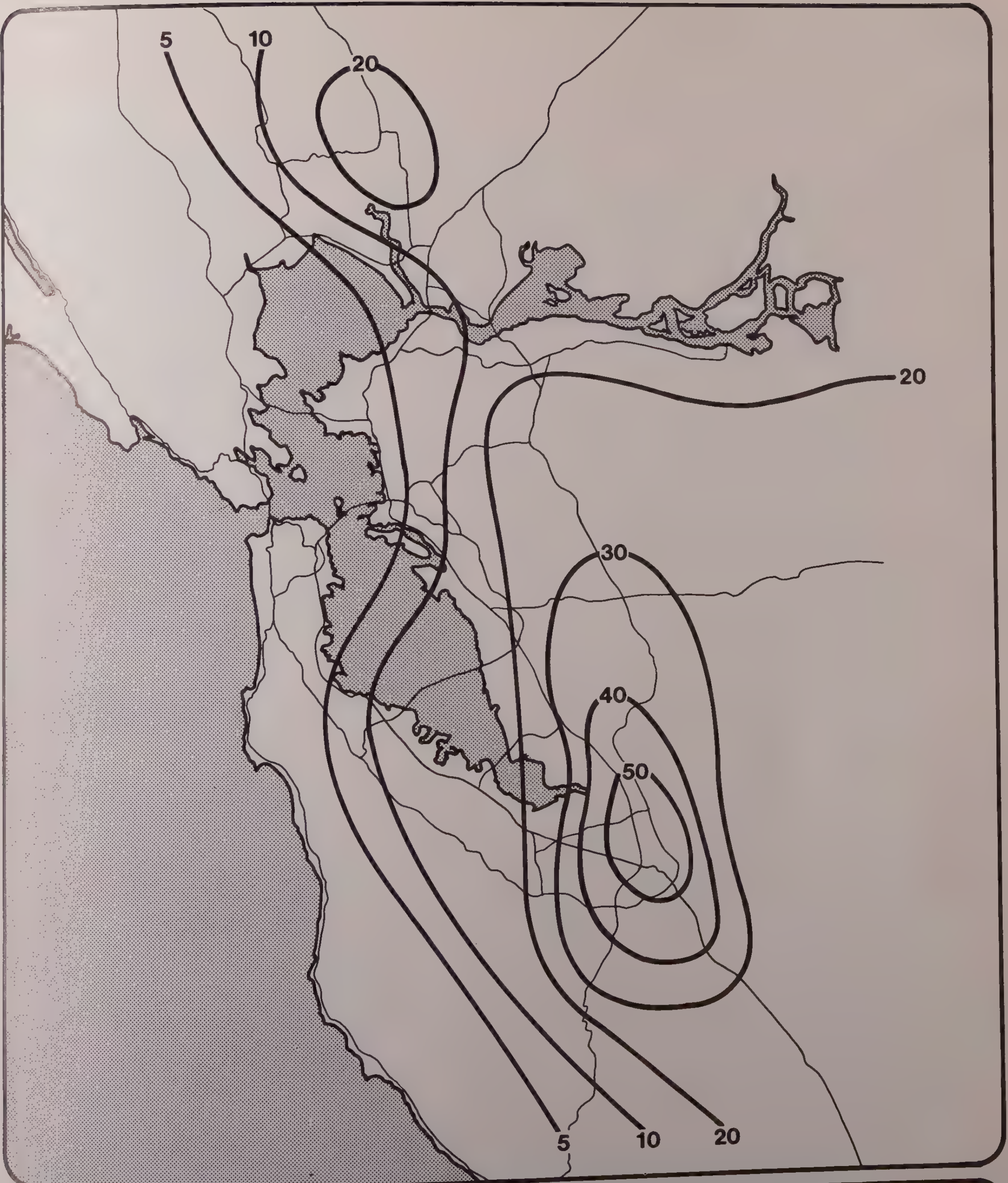

STUDY AREA
Legend:
Study Area Boundary
Subregional Planning Area Boundary
County Boundary
0 2 4 8 12 20
scale in miles
San Francisco Bay Region
WASTEWATER SOLIDS STUDY
Solano Co.
Napa Co.
Study Area Boundary
Napa Co.
Solano Co.
Napa-Solano Subregion
Solano Co.
Contra Costa Co.
Contra Costa Subregion
Contra Costa Co.
Alameda Co.
Livermore-Amador Subregion
Alameda Co.
Santa Clara Co.
South Bay Subregion
Santa Clara Co.
Monterey Bay
East Bay Subregion
Napa Co.
Sonoma Co.
San Pablo Bay
Contra Costa Co.
Marin Co.
Alameda Co.
San Mateo Co.
San Francisco Bay
Santa Clara Co.
San Mateo Co.
Study Area Boundary
San Mateo Subregion
San Francisco Co.
San Mateo Co.
Marin-South Sonoma Subregion
Study Area Boundary
Sonoma Co.
Marin Co.
San Francisco Subregion
Half Moon Bay
Pacific Ocean
Bodega Bay

Figure 2




# Air Quality

Number of Days in 1975 with
Oxidant >.08 ppm.

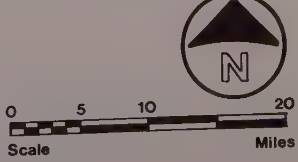
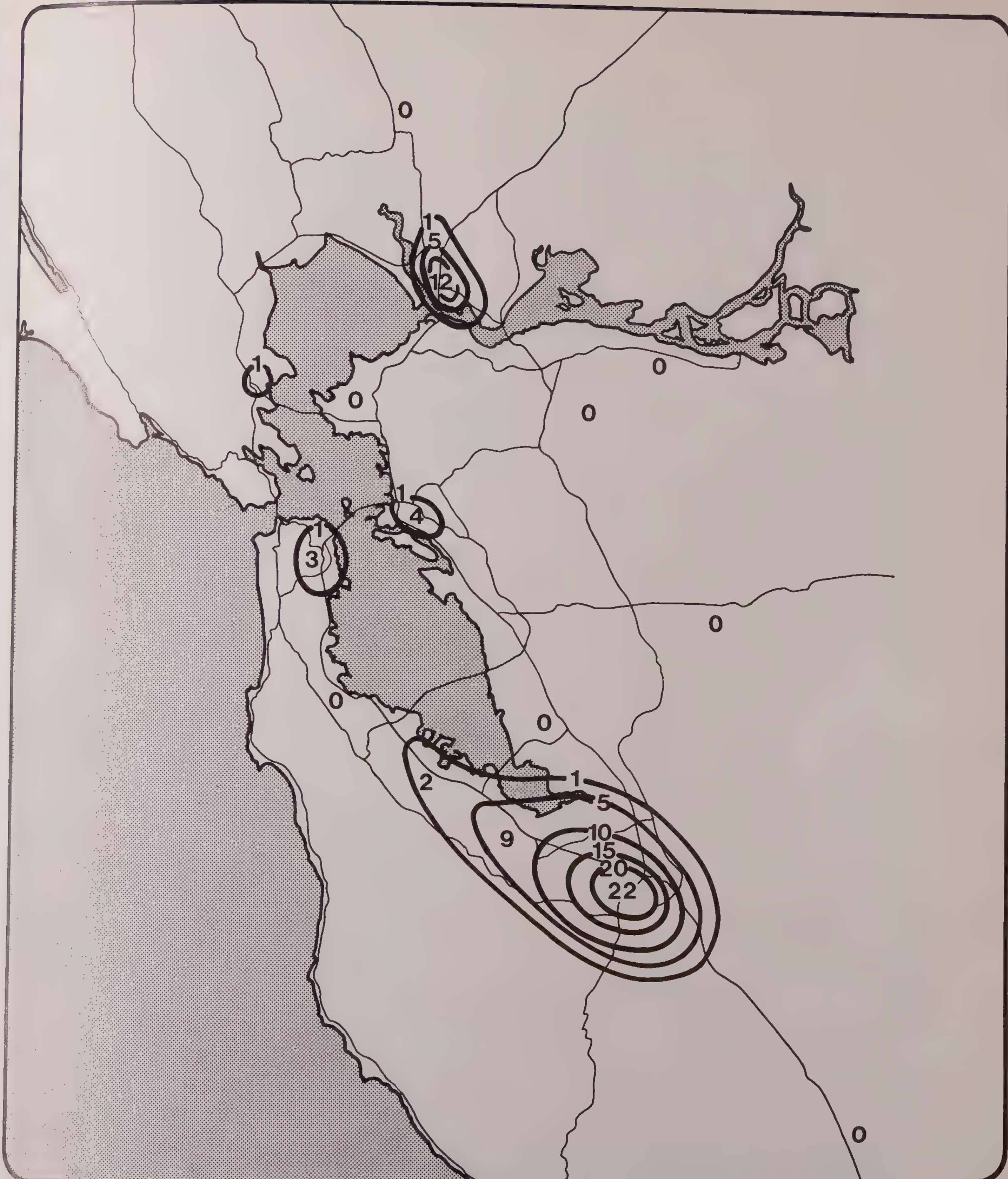


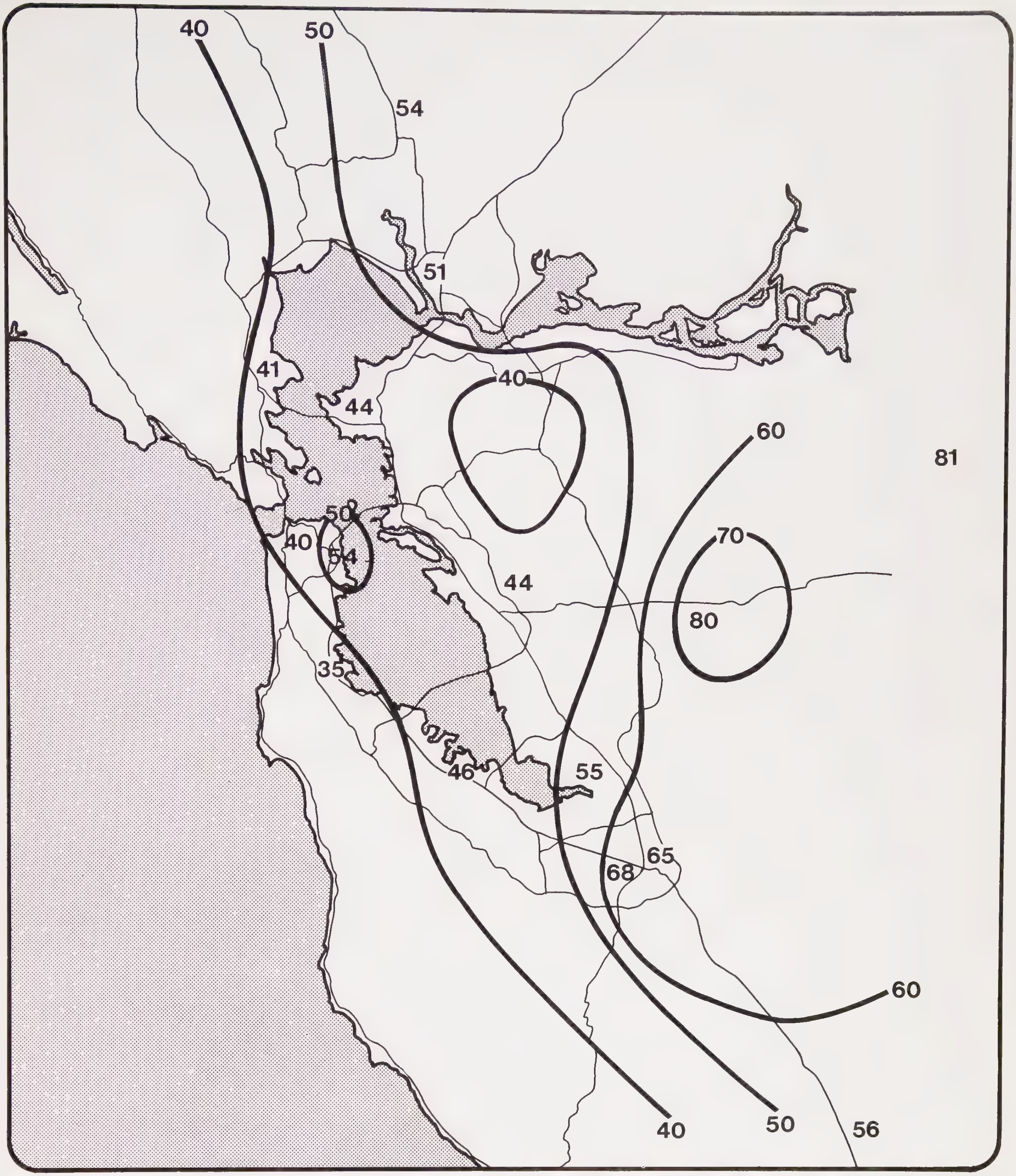

**Figure No. 3a**




# Air Quality

1975 Annual Number of Days with Carbon Monoxide Exceeding Federal Standard (9 ppm. for 8 hours).

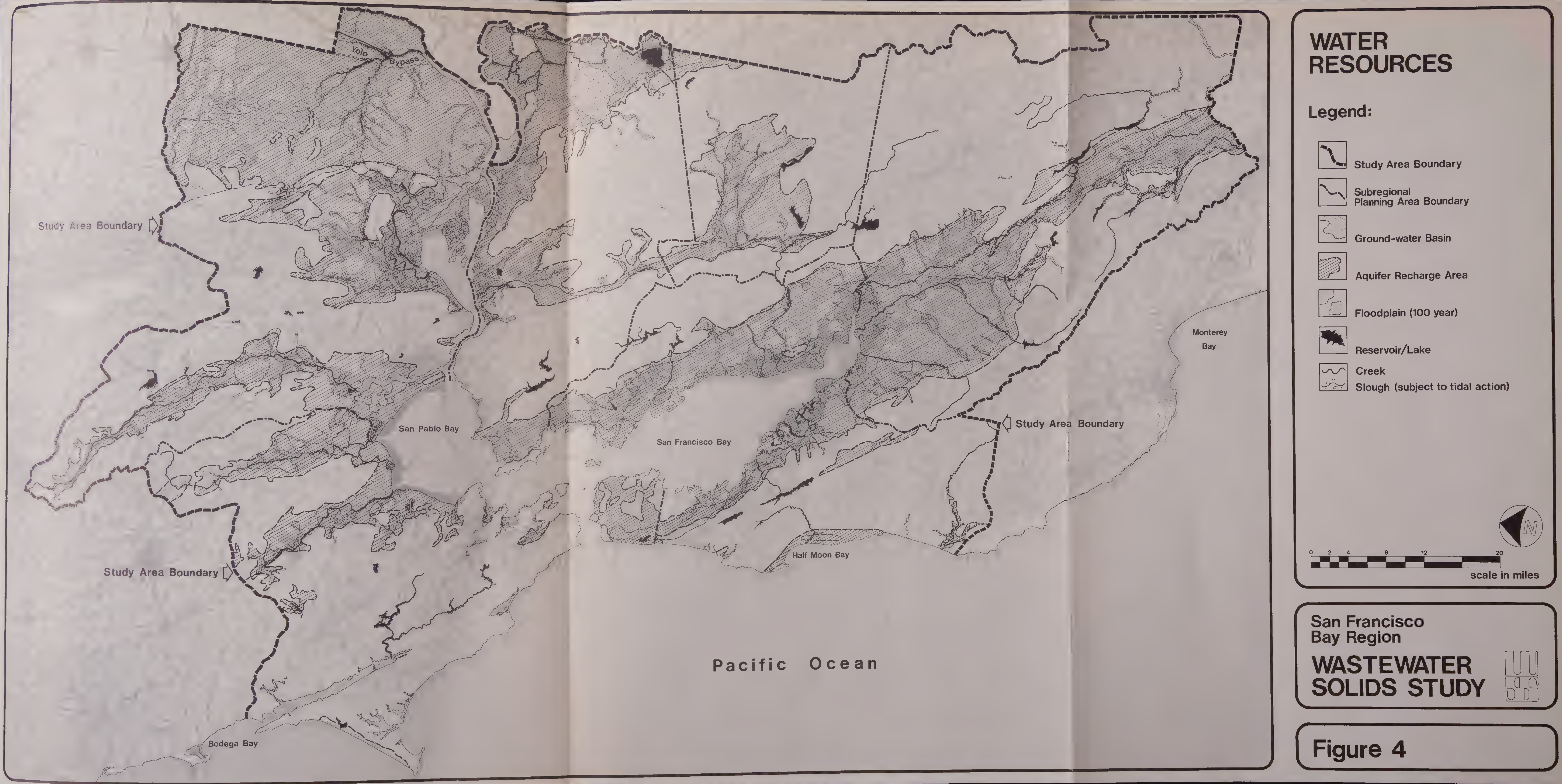
Figure No. 3b




# Air Quality

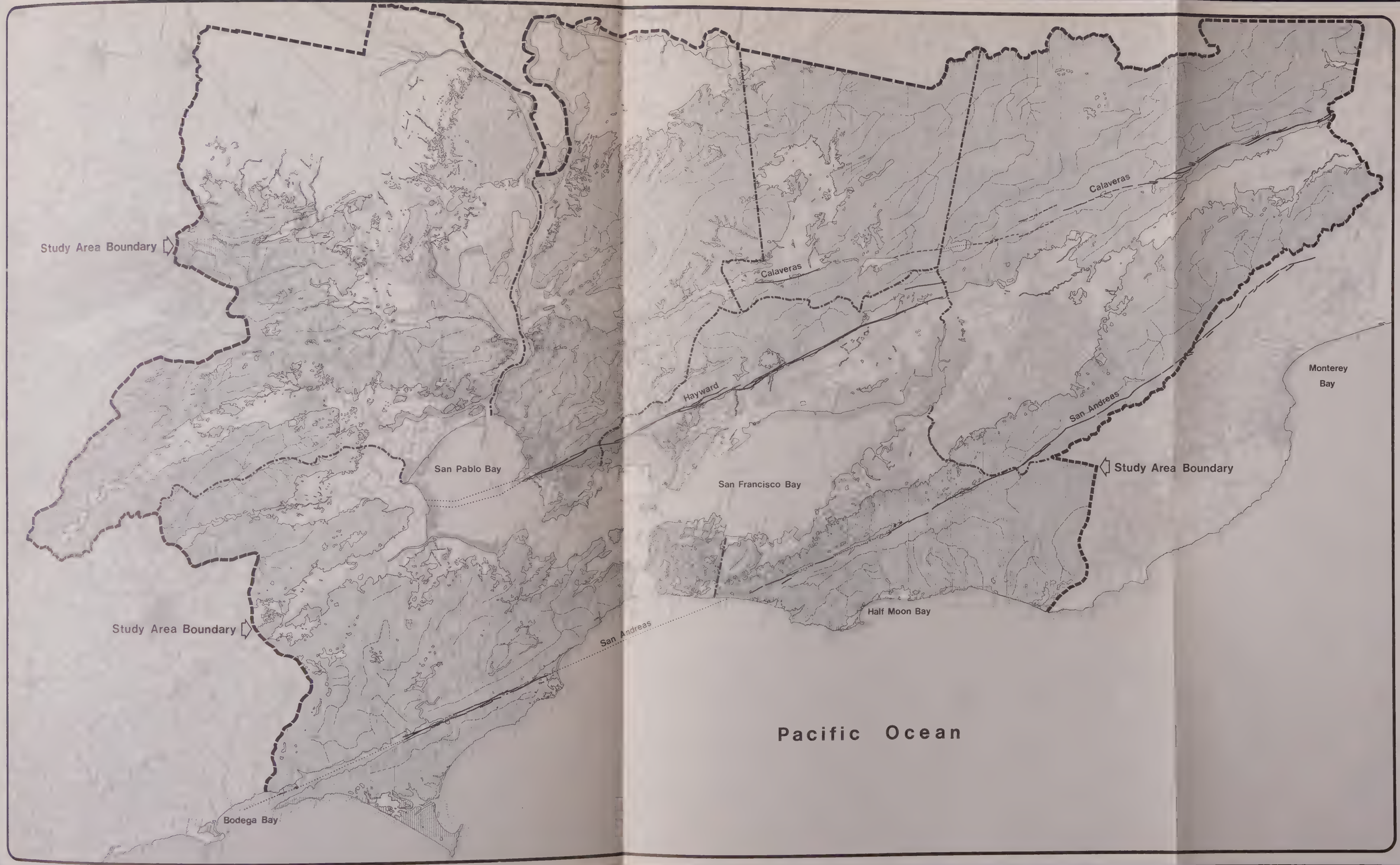
1975 Annual Geometric Means of Total Suspended Particulate in $\mu g/m^3$ (by hi-volume method with fiberglass filters).

Figure No. 3c




San Francisco Bay Region
**WASTEWATER SOLIDS STUDY**

## Figure 4




# TOPOGRAPHIC FEATURES

**Legend:**

- Study Area Boundary
- Subregional Planning Area Boundary
- Slope Greater Than 5%
- Fault (active, defined by surface break)
- Fault (active, surface break not verified)
- Fault (active, location approximate)
- Ridge Line

N

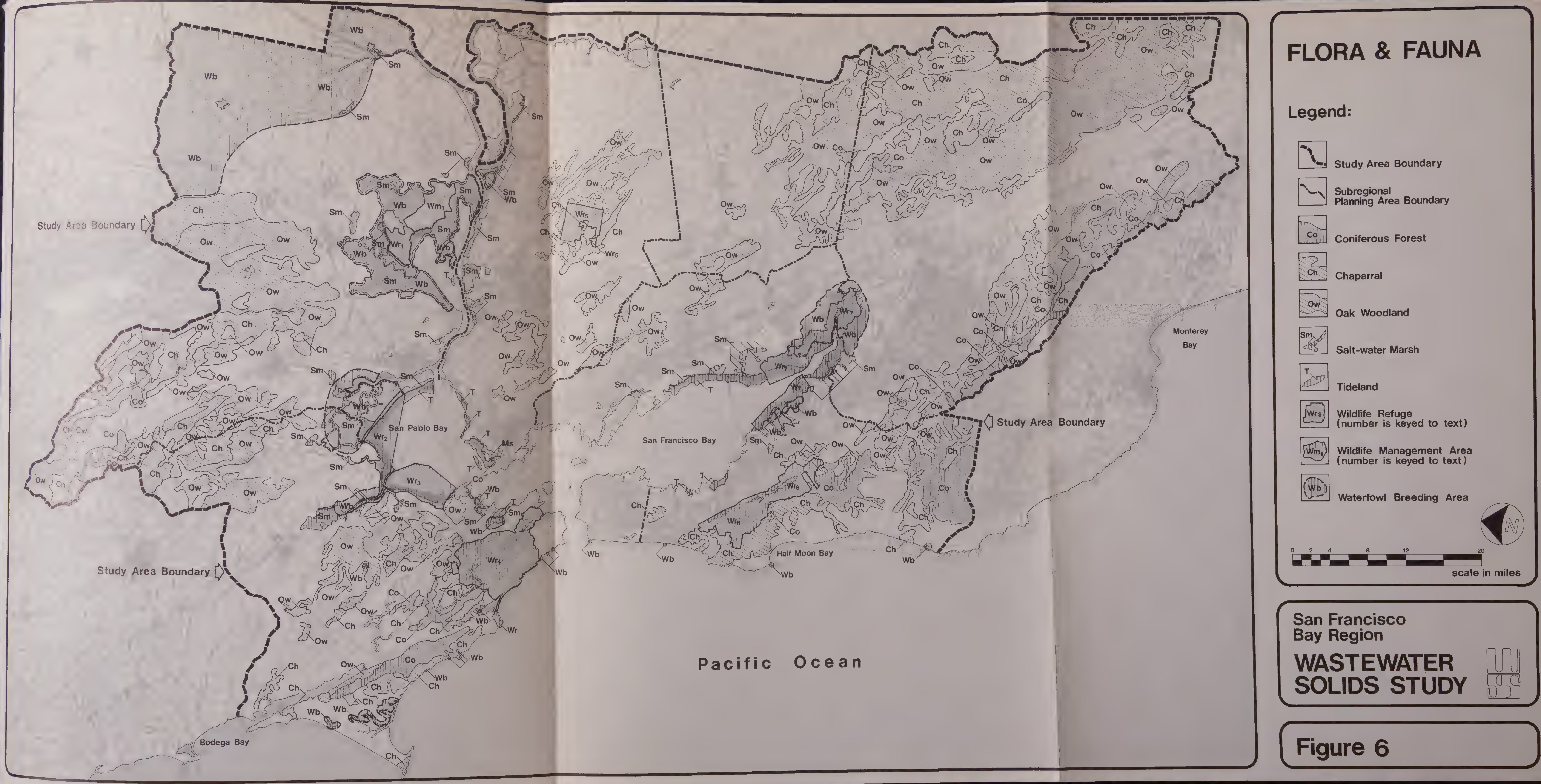
0 2 4 8 12 20

scale in miles

San Francisco Bay Region

**WASTEWATER SOLIDS STUDY**

**Figure 5**



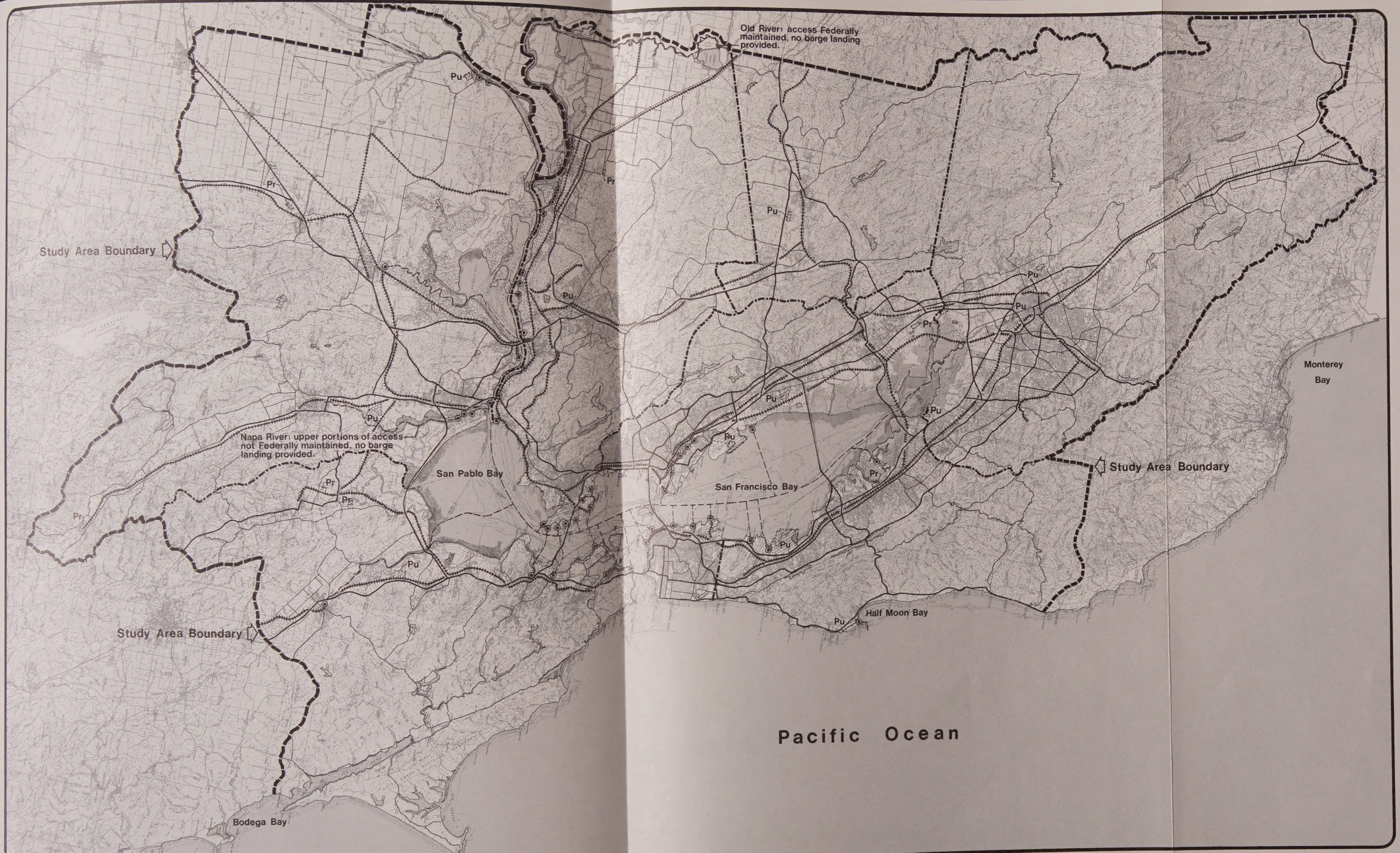

San Francisco Bay Region

**WASTEWATER SOLIDS STUDY**

**Figure 6**


San Francisco Bay Region
**WASTEWATER SOLIDS STUDY**

**Figure 7**




# TRANSPORTATION

**Legend:**

- Study Area Boundary
- Subregional Planning Area Boundary
- Primary Highway
- Secondary Highway
- Railroad
- Airport, (Pu=public Pr=private)
- Barge Landing, (with deepwater access or Federally-maintained access)
- Barge Landing (without Federally-maintained access)
- Ferry Route

0 2 4 8 12 20
scale in miles

San Francisco Bay Region

**WASTEWATER SOLIDS STUDY**

**Figure 8**